SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

AUTOMOBILE INSPECTION CAR FOR THE RAILROAD OFFICIAL

Vol. CXX. No. 15
October 11, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a year

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879

DIRECT ROUTES

"Direct routes" is the cry of today. Merchandise by MACK Trucks takes the straight, quick way to destination. Steel rails tap certain districts only. MACK Trucks tap them all—create business where the need for dependable transportation exists.

MACK constant day-after-day operation is only made possible by absolutely sound construction in every truck part. For instance, all holes in the frame of MACK Trucks are drilled, not punched, and all frame members, brackets, spring hangers, etc., are *hot riveted.* This is but one of many valuable MACK features that go to make a truck of uncommon performing ability and low operative cost.

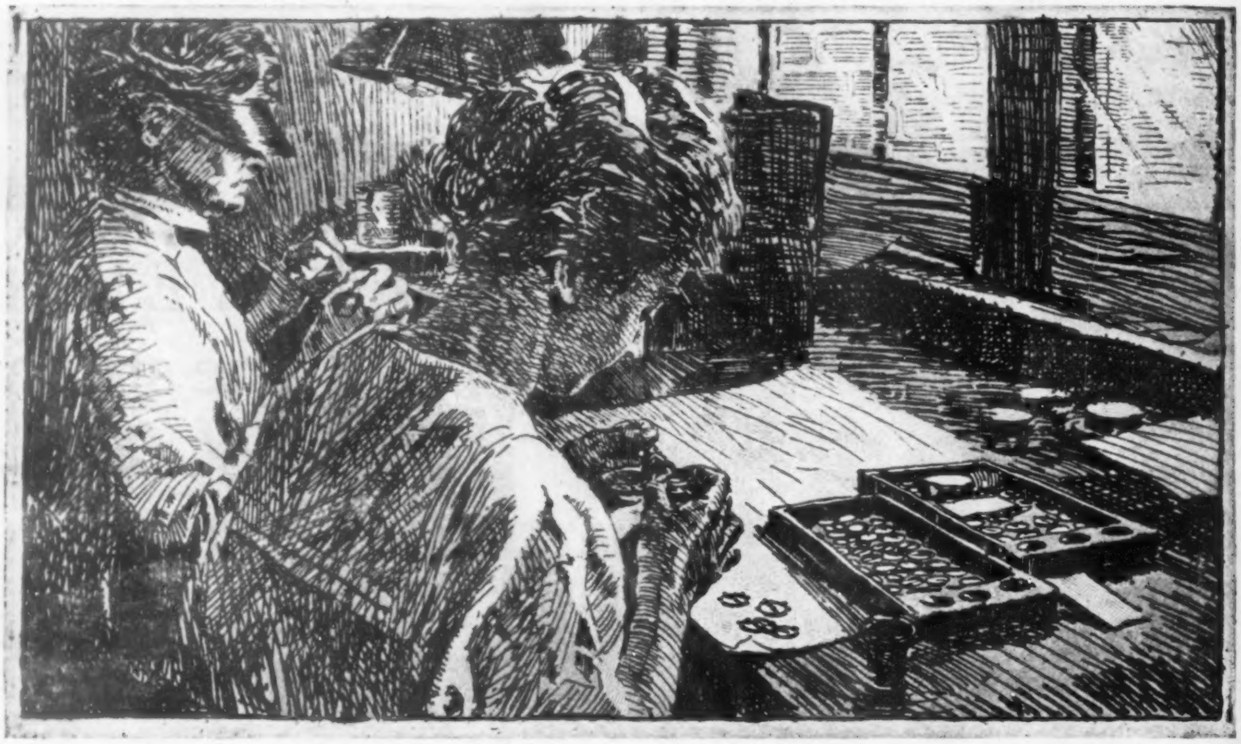
Capacities 1 to 7½ tons. Write for catalogue.

INTERNATIONAL MOTOR COMPANY, New York

Mack
TRUCKS

PERFORMANCE COUNTS

WALTHAM THE SCIENTIFICALLY BUILT WATCH AND THE FOREIGN BUILT WATCH



To Instruct and Protect You in Buying Your Watch

WE are all subject to temperature. There is a physical response to heat or cold. There is an expansion or contraction of the body's tissues which produces a distinct feeling. Thus we say, "The heat is 'melting' me" or "The cold is 'shriveling' me."

The balance wheel of a watch automatically allows for the difference in temperature that your watch may be subject to. In fact, the balance wheel is to a watch what a pendulum is to a clock—an automatic governor.

Owing to the expansion and contraction of metal, which, under heat or cold, would increase or decrease the diameter of the balance wheel, thereby affecting the number of time-keeping vibrations per second, the Waltham balance wheel is made of specially treated steel and brass, fused together and rolled under high pressure to produce the necessary temper after fusing.

Thus the Waltham balance wheel responds to varying heat or cold more readily than the balance in the foreign built watch, which is apt to be too soft and lacking in temper to keep perfect time or to be easily repaired.

In the making of this standardized Waltham balance wheel there are thirteen master stages and about six hundred detail operations.

The foreign watch balance wheel lacks the standardized uniformity in the fusing and rolling of the metals, so necessary to the time-keeping performance of the watch, which can only be produced by the specialized machinery developed at the Waltham shops.

One of the many reasons why the world's leading horologists came to Waltham for time was because they appreciated these scientific facts in Waltham standardization.

When you purchase a Waltham watch its time-keeping qualities will not vary with heat or cold. It is a watch that is "governed" in this respect by the last word in correct metallurgy to give its balance wheel a perfect performance.

This is one more scientific reason why your watch selection should be a Waltham.

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request. Waltham Watch Company, Waltham, Mass.

The Vanguard
The World's Finest Railroad Watch
23 jewels
$66 and up

WALTHAM

THE WORLD'S WATCH OVER TIME

SEVENTY-FIFTH YEAR

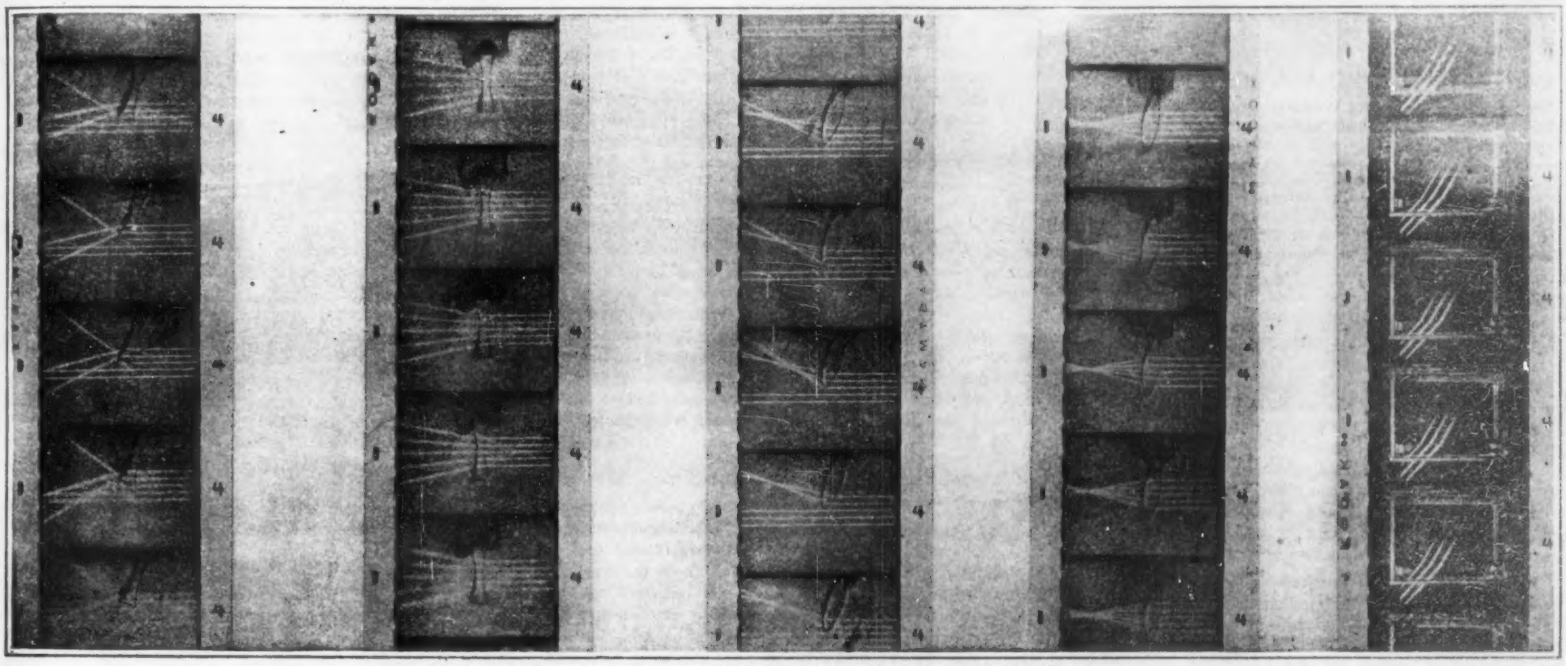
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV
NUMBER 15

NEW YORK, OCTOBER 11, 1919

10 CENTS A COPY
$5.00 A YEAR



Motion picture films showing the reflection and refraction of light rays

From left to right, these panels picture the insertion of the tip of a double concave lens into a parallel pencil of light rays; the passage of the rays through the central part of this lens; the insertion of the tip of a double convex lens in the same manner; the action of the full section of this lens on the rays; and the refraction of light on passing from air into water.

Filming a Lens in Action

By Carl F. Propson

THE motion picture has again revealed to us that which before was too swift for the human eye to discern—this time the subject being the action of a ray of light when it encounters an obstacle. Heretofore it has been possible to follow the performance of light when passing from the air into a medium of different refractive index, only by the help of the higher mathematics. Between the three factors: refractive index, length of focus and curve of surface, there exists a definite relation embodied in mathematical formulae, so that when any two of these items are known the third may be at once calculated. In practice this naturally resolves itself into practically a single formula: knowing the refractive index and the length of focus desired, to figure the proper curves.

If the formulae are correct, the severe scientist will insist that the mere ability to see the light at work on the two surfaces of the lens adds nothing to his knowledge of the situation. Doubtless this is so; but the world is an eye-minded world, and likes to see things at work. Accordingly most of us will be interested in tracing, by means of the motion picture film, the path of actual rays of light through the lens. Especially as a physical demonstration for laboratory students and others interested in the subject, such films possess much value.

In the making of the films which we reproduce on this page, pencils of parallel light-rays were produced, and lenses of various types were moved gradually into the field of these rays, so that the effect could be observed as each of the rays in succession was intercepted by the successive regions of the lens. We show the initial and final stages of this process when carried out with a double-concave lens. It will be noted, in general, that the ray when it falls upon the lens is partly transmitted and partly reflected, the transmitted part being much the stronger.

The lens was thrust into the path of the light so that the incident rays fell almost perpendicularly upon the surface of the glass. There is accordingly little refraction here, the ray passing into the glass almost in a straight line. The angle of incidence is not exactly 90 degrees, as is demonstrated by the fact that the faint reflected ray does not fall back upon the incident ray; but as remarked, the divergence from the true perpendicular is not sufficient to produce marked refraction. The reverse is the case where the ray emerges from the other side of the glass. An extreme case of internal refraction is seen in the case of the rays which pass out at the top of the lens, and of which the fainter portions are substantially reversed in direction—not through reflection, but through refraction. In fact, these rays behave in a manner altogether different from that exhibited by the rays passing normally through the body of the lens; for the major part is internally reflected downward and forward, crossing the paths of its brother-rays that suffer normal refraction.

When we get the central portion of the double concave lens at work on the sheaf of rays, we see very clearly the divergence of the major refracted rays on the far side of the lens, and the convergence to a focus of the minor reflected segments on the near side. We can also observe that the rays are slightly displaced on entering and leaving the lens—more, of course, on the latter occasion than on the former, just as they are more seriously deflected from their course; and for the same reason, that after suffering the preliminary deflection on entering the glass, they strike the surface on leaving at a sharper angle.

The double convex lens gives results in close harmony with these. Here again the ray striking the top of the lens—which here is the extreme point of the apex—are exceptions to the general action of the lens. Instead of being transmitted to the focus at which all the other rays passing through the lens meet, they are even more sharply bent toward the center, so that they pass across the paths of the other rays and inside that focus. The convergence and divergence are of course here reversed, the minor reflected rays diverging backward, and the major refracted portions being brought to a focus beyond the lens. It is notable that the minor reflected portions of the rays are here considerably fainter than in the case of the concave lens, while the displacement of the ray on entering and leaving the glass seems a trifle more noticeable. It is also to be observed that there is a very pronounced internal reflection of the light back into the lens at the points where the rays re-enter the air. This latter reflection, however, fails to take place in such well defined lines; it seems that it might almost be termed a diffusion.

An interesting companion piece to these lens films is the strip showing the behavior of light on passing out of air and into water. The strong refraction is here exhibited elegantly, and also we must be struck with the manner in which the absorption of the rays by the fluid shows up.

Russia's Industrial Standing.

In the last ten years before the war Russian industry was continually gaining in importance. The country, which had been hitherto exclusively agricultural, had become almost entirely independent of foreign markets for a great number of important industrial products. Backed by strong support on the part of the Government, a number of financial and industrial leaders strove to put Russia in a position to provide entirely for her own needs.

At first the war greatly stimulated industrial development. It is quite comprehensible that in the very field where Russia was so dependent upon Germany a strong effort was made to become all at once entirely independent and self-sufficient.

With strong Governmental support a great number of new industries rose. A venture was even made to manufacture incandescent light bulbs. The capacity of the new factories was by far insufficient to satisfy all the requirements of Russia, but the foundation was laid for many new branches of industry. And while unsettled conditions have since crippled all business, it is hoped that the rejuvenation of Russia will show that everything will not have to go back to the very beginning and build afresh, but that some of the good work done will remain.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.

Founded 1845

New York, Saturday, October 11, 1919

Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Important Notice to Our Readers

Owing to the strike which is now in progress in New York City, we are having great difficulty in publishing the Scientific American. We hope to be able to mail the issues for the following two or three weeks, but we beg the indulgence of our readers should they not receive the paper on time, or should it be found impossible to mail the paper until the strike is over.

We may possibly be obliged to suspend temporarily the publication of the Scientific American Supplement.

Speed in Airplane Travel

THAT very successful airplane designer, Grover C. Loening, once made the surprising but perfectly true statement that the speed requirement for successful commercial aviation is more important to-day than it will be several years from now. In the course of a paper on the value of speed in commercial airplanes, he explained this on the ground that airdromes are less frequent and are more remote from cities than they will be in the future, and therefore, speaking of the business man, the time from office door in one city to office door in another must include a motor-car ride to the airdrome, which will generally be far longer than the taxicab ride to the station.

Mr. Loening, whose monoplane is one of the fastest machines of the day, shows the significance of higher speed in an analysis of a business man's trip by airplane, from an office in New York to an office in Washington, D. C., by an airplane making 70 miles an hour. From his office door in New York to Belmont Park would take about 50 minutes, and from Anacostia landing field to his Washington office door about 30 minutes, making a total of 4 hours and 50 minutes, which is certainly not enough less than the train time to warrant the added expense and trouble of going by the air route. But if the airplane could maintain 170 miles per hour, it would travel from Belmont Park to Anacostia Landing in an hour and a quarter, and with the same connecting trips to offices, the total time from office door to office door would be 2 hours and 35 minutes, which is less than half the train time. Thus a business man could leave his New York office at 8 A. M., reach Washington at 10.35, leave Washington at 2 P. M. and arrive at his office at 4.35.

The above estimate assumes perfect weather conditions with no wind. But let it now be supposed that a 20-mile head wind is blowing. A 70-mile-per-hour machine will take about 4½ hours for its flight, making a total of almost 6 hours, which is longer than the train time; while the 170-mile-per-hour airplane will make its flight at 150 miles per hour, in 1 hour and 28 minutes, making a total time of 2 hours and 48 minutes from office to office. The fast machine is less dependent on the weather.

We are entirely in agreement with Mr. Loening, in his statement that under existing conditions, whatever the future may have in store, very high speed is necessary if inter-city travel is to surpass railroad travel in the matter of time consumed on the total journey.

What to do with a Preface

TIME was when the dutiful reader, on taking up a book, turned first to the preface; only after reading this did he feel that he could decently attack the body of the book. To-day we are apt to go to the opposite extreme, and ignore the introductory remarks altogether. It has always seemed to us that both of these procedures were faulty.

To be sure, sometimes the author gives us a preface in which he says nothing, presumably because he has nothing to say; but in such event his book is probably open to the same criticism, and it doesn't matter much what part of it we read in order to find this out. On the other hand, if the preface has a message, it seems a shame to pass it over deliberately unread.

This, however, does not signify that we advocate beginning a book with the preface. It is to be assumed that if the author has produced a book that can be read enjoyably, he had some purpose in mind in writing it. He is then pretty certain to tell us in his preface, either explicitly or implicitly, what that purpose was. And we object to being told the purpose of the book before we have read it. When we submit to this treatment, we always feel in the position of the spectator at the cheap show, where the performer says "Ladies and gentlemen, I am now about to do so-and-so; watch me carefully, for the hand is quicker than the eye."

The bare fact is that—whether at sleight of hand or at the more respectable play of juggling words—if we know what a performer is trying to do, our judgment as to the success with which he does it is affected. The human race, broadly speaking, may be classified in the two groups of the complaisant and the obstinate. The complaisant man, if you tell him beforehand what you are trying to do, is likely to concede that it is done, without further ado. The obstinate brother, on the other hand, will immediately challenge you to show him that you can do it, and will hold out to the bitter end that you haven't done it and can't do it. The only thing that can happen to the reader who turns first to the preface is that his judgment of the author's performance will be biased, in the one direction or the other.

If the book is read first and the preface last, however, which is the procedure we want to advocate, the book can be enjoyed and taken at face value without the distraction of watching the author to see if he is living up to his announcement. We can even have the pleasure of guessing what it is that he wants to accomplish, and later checking that guess against his confession. Or if we resist this temptation, we can at least turn back to the preface, after having read the book in peace, and with the work before the mind's eye as a whole, decide whether the author has accomplished what he set out to do.

Present Status of Our Merchant Marine

WITH the exception of the men who are engaged in shipping, it is probable that the country has a rather vague idea as to the exact status of our merchant marine. This is not the fault of the Shipping Board, whose publicity has been voluminous and very conscientiously carried on. If there is any uncertainty, it is due to the unfamiliarity of the public with shipping terms, and the impossibility, in such enormous and complicated operations as those of the Shipping Board, of making clear to the public just how matters stand. The Shipping Board, however, has recently sent out an illuminating statement, which gives the salient features of our shipbuilding activities from September, 1918, to September, 1919, from which these particulars are taken:

On August 29th of the present year, the sea-going tonnage under control of the U. S. Shipping Board showed a total of 5,313,780 gross. Of this amount there had been built by the Shipping Board 777 steel vessels totaling 3,511,918 gross tons; 315 wooden vessels of 728,079 gross tons and 15 composite steel and wood vessels of 35,000 gross tons. It included also 94 vessels of 567,490 gross tons, which had been seized from Germany and one Austrian vessel of 8,312 gross tons. Also there had been purchased from Japan 15 vessels of 85,880 gross tons and from Austria 5 vessels of 30,521 gross tons. It included also 58 vessels of 346,580 gross tons which had been requisitioned from private owners. The grand total of 5,313,780 gross tons represented 1,280 ships.

It should be mentioned that the foregoing tabulation does not include 122 steel ships of 310,497 gross tons and 63 wood vessels of 164,655 gross tons which were sold recently to private owners by the Shipping Board, nor does it include seized foreign vessels that had been sunk.

It is a curious fact which we should never lose sight of, that due largely to our late entry into the war, we are the one nation among the allies, that has actually come out of the war in a stronger financial and industrial position than before, and this is particularly true in regard to shipbuilding. Before the war we held what the Shipping Board terms an "inconsequential place among maritime nations." Up to the outbreak of the war we had only 15 vessels of 1,000 tons and over, engaged in over-sea trade; to-day the American flag floats from 1,280 ocean-going steamships, 1,107 of which have been built by the U. S. Shipping Board within the last two years. If we include the shipping on the Great Lakes, the totals are even more impressive, for in June, 1914, the total tonnage under the American flag, including coastwise shipping and the fleet operating on the Great Lakes, was 4,287,000 gross tons, whereas in June, 1919, the over-sea coastwise and Great Lakes shipping had reached a total of 11,983,000 gross tons. The corresponding gross steam tonnage of the world, in ships of 100 gross tons and over, on June 30th, 1919, as reported by Lloyds, consisted of 24,386 vessels of 47,897,000 gross tons. How severely the Shipping of the world, outside of ourselves, was crippled by the enemy action through the war, is shown by the fact that the total losses reached about 15,000,000 tons, of which nearly 8,000,000 tons was lost by the British alone.

The operations of the Shipping Board were designed to meet a great war emergency. The enemy submarines were sinking merchant shipping at an accellerated rate, and a cry had come across the water that the most urgent need of the moment was for ships in unlimited numbers. The answer was the laying down of a great number of yards, some of them like that at Hog Island and Newark Bay being far larger than anything existing in the world. A system of building ships on the "fabricated" method was introduced and the aim was to put into the water in the shortest possible time, types of ships which lent themselves both in size and method of construction, to a very rapid output. It was for this reason and this alone that a large program of wood ships was started, and for this reason also the size of the majority of the ships was kept down from about 2,800 tons to about 6,000 tons. Consequently when the war ended, a revision of the plans was made and it was determined to sell the wood ships and a large number of the steel ships and confine new contracts to vessels of larger size and greater speed. A large number of contracts also were cancelled.

The original construction program contemplated the building in this country, of 11,871,000 gross tons of shipping made up of 2,105 steel steam ships of 9,568,000,000 gross tons; 1,017 wood steamships of 1,985,000 gross tons; 50 composite vessels of 116,667 gross tons and 43 concrete ships of 201,300 gross tons.

Now, of this total program there have been built to date 899 steel steamships of 3,822,415 gross tons; 378 wood steamships of 892,735 gross tons, and 15 composite steamships of 35,000 gross tons, making a total of 4,750,150 gross tons delivered. We have fitting out in wet basins, 408 steamships of 1,280,483 gross tons and on the ways there are 497 ships of 2,190,736 gross tons. We have also under contract, although no work has as yet been done upon them, 227 steel steamships, of 984,407 gross tons. Contracts have also been cancelled and suspended on 886 ships of 3,010,189 gross tons.

From the above figures it will be seen that the following work yet remains to be done:—

Completion of vessels launched but not yet delivered, 1,280,483 tons. Completion of vessels whose kiels have been laid, 2,190,736 tons. Completion of vessels under contract, 984,407 tons, making a total tonnage on which work yet remains to be done, of 4,455,626 tons.

Of equally, if not greater importance than the construction of ships, is the provision of a well trained sea-going personnel. At the present time we have 4,592 deck officers and 4,592 engineering officers. The deck force consists of 15,720 men and the engine and fire-room force of 18,720 men. In the stewart's department there are 7,936 men, making a total personnel in our merchant marine under the Shipping Board, of 51,560.

Salving Vessels with Limpets

OUR readers were made familiar last year with an ingenious device for salving vessels, which consisted of a heavy steel sphere, containing means for drilling and cutting through the side of a vessel. The machinery was controlled by two men within the sphere, and the tools were driven electrically by current transmitted from a tender at the surface. In some cases a vessel is so settled on the bottom that divers cannot pass beneath it to attach the slings and cables, and to meet this difficulty a new method called the "Limpet System" has been devised by which it becomes possible to attach wire hawsers to the hull of a sunken vessel. According to Marine Engineering of Toronto, the limpet is a soft iron body, carrying a number of drill taps driven by small motors, the current being supplied from the salvage vessel. The limpet is lowered until it comes in contact with the hull of the vessel, when it is magnetized, causing it to cling to the plates. The drills are then started, and after running a predetermined length of time the current is switched off, the limpet is hauled to the surface, and the drills are left tightly fastened to the ship's hull. The ends of these drills are formed into eyes, to which the hawsers can be attached.

This method would be available for use either with lifting gear installed on salvage vessels at the surface or with pontoons of the kind intended to be sunk, attached to the vessel, and then pumped out—their buoyancy raising the wreck sufficiently for it to be towed into shallow water, when the process is repeated.

It may not be known that the majority of the vessels sunk by submarines went down in rather close proximity to the coasts of the British Isles, where the water is comparatively shoal. Hunlreds of these have been salved, and the work is still going on.

Naval and Military

Our War Casualties 322,182 Men.—The latest official figures, giving our war losses in dead and wounded, show that we lost 116,492 dead and 205,690 wounded, a total of 322,182. This includes army and marine losses on all fronts during the war and from the Armistice to Sept. 1, 1919. Of this total 35,585 were killed in action, and 14,472 died of wounds, making a total of 50,057. Disease accounted for 58,073, and 8,092 died of accidents and other causes. There are no "missing," all of those so reported having been accounted for.

France Purchases All A. E. F. Property.—A contract was recently signed by France and the United States by which the French government will pay to the American Government $400,000,000 for all of the American expeditionary Force property in France, except that allotted for return to this country and for the use of United States troops remaining in France. The estimated original cost of all the property of the A. E. F. in France on July 8 was $1,700,000,000, and the estimated original cost of all of that part available for sale to France was $1,300,000,000. The War Department's estimate of the value of the property sold to France was $749,000,000.

An Airship Consists of 20,000 Parts.—Some interesting facts regarding the work required in building a large modern airship is given in a recent issue of The Engineer, which states that the general problems of design are closely allied to those of naval architecture; although the airship designer must be a highly skilled mechanical engineer, and also must have a knowledge of textile technology. For the work of construction, owing to the multiplicity of parts required, a very efficient shop organization is necessary. In a rigid airship structure, excluding the machinery, there are 20,000 different parts, a total length of structural material of 20 miles, 60 miles of wire, and over 2,000,000 rivets.

Navy's Great Airship Hangar.—The Navy is purchasing its first rigid airship in England at a cost of $2,500,000. To house it a huge hangar is to be erected at Lakehurst, N. J., which will be 800 feet long, 265 feet wide and will have a clear inside height of 174 feet, while the total height from the ground to the peak of the roof will be over 200 feet. The steel framework will be over 6,000 tons. Two elevators and several stairways will lead to the roof. The many shops necessary for the maintenance of the airships, will be built in between the great arched trusses that support the roof. Three railroad tracks will run the entire length of the building. The hangar will be large enough to hold one ship of 10,000,000 cubic feet capacity and a smaller one at each side, or two 5,000,000 cubic feet ships side by side.

United States and German Submarines Compared.—Five of the German U-boats were surrendered to the United States. The Navy Department recently carried out identical comparative trials between U-111, built at Kiel in 1918, and S-3, designed by the Navy and built at the Portsmouth Navy Yard. The boats are practically identical in dimensions, the surface displacement being about 840 tons. On the surface U-111 made 13.8 knots; S-3 made 14.7 knots. Submerged, U-111 made 7.8 knots; S-3 made 12.4 knots. U-111 can cruise 8,500 miles at 8 knots; S-3 can cruise 10,000 miles at 11 knots. S-3 showed an equal preponderance in submerged cruising. S-3 is less crowded, more comfortable for the crew, and behaves better in a seaway.

A Channel Leader Gear for Finding Channels.—An important application of an electro-magnetic effect which was developed during the war is found in what is known as the Leader Gear. This, according to the London Times, consists of a cable laid along the bottom of a tortuous channel leading through a mine field or into a harbor. If an alternating electric current be passed through such a cable it is possible, by means of devices on a ship, to obtain either aural or visual indications of the presence of the cable, and by this means a ship can be guided in fog or darkness at high speed with almost as much precision as a trolley car is guided by its trolley wire.

British Submarines in the War.—In 1914 the latest British submarines were of the "E" type, 180 feet long and displacing 660 tons at the surface with a surface speed of 15 knots and a submerged speed of 10 knots. A little later they carried wireless with a range of about 350 miles. Then followed the "V" class, 147 feet in length and the "G" class, 187 feet in length, the latter being of 700 tons surface displacement. Next came the "J" class, 275 feet over all, with surface displacement of 1,210 tons and submerged displacement of 1,820 tons, with a surface speed of 19 knots. The latest class was the celebrated "K" boats, 338 feet long, 1,880 tons surface and 2,650 tons submerged displacement, driven by 10,000 horse-power, steam turbines, at 24 knots on the surface.

Automobile

Side Plates for Spoked Wheels.—The disk wheels recently offered to motorists are becoming more and more popular so one of the recently developed automobile accessories is a pair of light sheet metal disks that can be applied to the ordinary wood and wire spoked wheel to enclose it and give the general appearance of the latest development. While such disks do not add appreciably to the strength of the wheels, they do give the advantage of thorough enclosure that makes cleaning the wheels an easier process.

Fabric Universal Joints.—A number of automobile and motor truck manufacturers have used flexible fabric couplings or universal joints with considerable success and claim advantages of noiseless operation and no appreciable depreciation after extended periods of use. Every time the clutch of an automobile, especially a heavily loaded truck, is engaged and the vehicle started, a heavy shock load is imposed on all parts of the transmission system. It is stated that the rubber and fabric disks that form the driving element yield sufficiently to cushion the shock appreciably and that this has a favorable influence on life of drive shaft and axle parts and even of the rear tires. Another advantage is that they require no greasing and aside from an occasional tightening of the spider arm bolts, need no adjustment. As far as strength is concerned, torsion tests have twisted driving tubes and shafts without shearing the disks. The metal universal joint types have the big advantage of permitting greater angular displacement of the driven and driving members than is possible with the fabric disk and spider types, so the use of the latter is restricted to "straight line" drives or where the inclination of the driving shaft is but a few degrees from the horizontal.

Special Industrial Automobile.—The application of the gasoline engine to the industrial truck-tractor gives this universal prime mover a broad field of usefulness as the new machine can be used in factories, foundries and warehouses for moving goods and other work on which the heavier motor trucks cannot be employed to advantage. The machine is a three-wheel type, but unlike more conventional tricycles, the two traction members are in front, a single wheel at the rear being used for steering. In fact, the design is directly opposite to that of the automobile because the radiator and power plant mounting is at the rear, the driver sitting over the engine. The power plant is a conventional four-cycle, four-cylinder block type with a bore of 3⅛ inches and a stroke of 4½ inches. The wheelbase of the machine is 72 inches, the tread about three feet, the height to the body floor is but 28 inches and the capacity is 1½ tons as a truck. The wheels are provided with solid rubber tires and the speed varies from one to 15 miles per hour. The control is in all fundamental respects the same as that of an automobile, yet the three-wheel construction makes it possible for the tractor and its trailers to describe curves of small radius, a feature of some importance in industrial work in warehouses and factories.

Systematic Maintenance Important.—The average motorist or truck owner does not appreciate the need for systematic inspection and oiling of automobiles to secure best results. In railroad practice an express locomotive is inspected at the end of every 80 to 100 miles run, the freight engine is gone over every 150 or 200 miles. The work is so systematically done that as many as five or six inspectors may be working on the locomotive at once as each is responsible for certain groups of parts. As a result of this careful inspection, passenger locomotives run about 125,000 miles without an overhauling and freight engines 100,000 miles. When a motor truck or automobile chassis receives periodical inspection, cleaning and lubrication, its life is greatly increased and liability of breakdown on the road is reduced to a minmum. When one considers that the usual truck or car is not driven by an expert, or over smooth steel rails as the locomotives, the importance of giving the mechanism proper attention to insure uninterrupted motor transportation should be apparent to the least technically-minded.

Accessory Leagues Often Worthless.—The motorist should be warned against solicitors who are endeavoring to secure subscriptions or memberships to various leagues or associations which purport to give their members exceptional bargains in motor car supplies. As a rule the annual fee is small but the service rendered by the pirates preying on legitimate commerce is so slight that no matter how low the "initiation fee" or "dues" is it will be an expensive investment. Catalogs are issued that list standard supplies at low prices as a bait but when they are ordered, substitutes of inferior grade are usually supplied because the others are "out-of-stock." The motorist will save money and trouble in the end if he obtains his merchandise from reputable firms who count the good will of the buying public as an asset.

Electricity

Testing Hardness Magnetically.—A British firm has developed an apparatus for testing the physical qualities of steel after heat treatment by means of the magnetic method. The principle on which this instrument is based is that magnetic retentivity of a steel is a function of its hardness. The method of using this apparatus is as follows: First a specimen (usually a turned piece 3 inches long by 1½ inches in diameter) is subjected to the heat treatment required to be investigated. It is then tested for magnetic hardness by being laid inside a standard magnetizing coil, and a direct current from the mains flashed on to the coil which magnetizes the steel to saturation. The specimen is then removed from the magnetizing coil and is placed in a small search coil, which is directly connected to a Grassot fluxometer, continues *Automotive Industries*. The specimen is then sharply removed from the ballistic coil and a reading is obtained on the fluxmeter, which represents the hardness of the specimen. The scale of the fluxmeter is divided in terms of Maxwell-turns. With the search coil of correct design, the reading is also given in terms of C. G. S. units of coercive force, so that the results are in international units.

Something New in Radio Communication.—According to a leading Norwegian newspaper, Engineer Hermod Peterson has recently patented a device for the production of electrical current for radio telegraphy. The electricity is received by an accumulator, which releases it at certain intervals. The system is sparkless, and the sounds are clearer than in the older inventions. The clearness of sound depends upon the regularity of the current, and with this system the current is released with a mathematical exactness. The device has further advantages in that it is cheaper, simpler, and more durable than those now in use. If the claims for this invention prove well founded, it is thought that it will mark a distinct step in advance of what has so far been accomplished in this line, and hence its possibilities are creating considerable interest in the radio world.

Wireless Between United States and Germany.—Wireless communication with Germany has been resumed in a limited way by the American Government, according to *Wireless Age*. Business communications between American houses and their agents in Germany are accepted at New York at 44 Whitehall Street, and other points where the Navy has district communication officers for transmittal to the trans-Atlantic wireless stations at the Navy Department there and at Otter Cliffs, Me., where they are dispatched to the receiving station at Nauen, Germany. Similar communications are dispatched from Nauen to the United States receiving stations. Press dispatches to the extent of 500 words from this country and a similar number of words from Germany are also accepted daily.

Extending Railroad Electrification.—It is announced that electric current is about to be turned on over another 110 miles of main line of the Chicago, Milwaukee & St. Paul Railroad, or from Othello to Cle Elum, Wash., including a crossing of the Columbia River. By January 1st next the remaining 135-mile stretch of the road from Harlowton, Mont., to Seattle, will be completely electrified, 885 miles in all, or within 200 miles of half the entire length of the St. Paul-Seattle line. The last stretch from Cel lum to Seattle, 130 miles, will cost about $9,000,000, or 25 to 40 per cent. more, relatively, than preceding units, on account of higher prices of labor and material.

Inspection and Life Tests of Incandescent Lamps.—The total number of lamps offered for delivery to the Government purchasing authorities during the past fiscal year was over 5,000,000, of which about 600,000, or 12 per cent., were rejected on the initial inspection at the factory, which covers the mechanical qualities of the lamps and their rating in regard to power consumption and efficiency. In this initial inspection samples are selected for the burning or so-called life tests. During the year nearly 3,500 lamps were subjected to this life test, and with few exceptions the tungsten lamps, both vacuum and gas-filled, supplied under Government contracts, had a life considerably in excess of the 1,000 hours of burning required by the standard specifications.

Ingenious Wire-Holders.—An American manufacturer of electrical equipment has just introduced what he terms a wireholder, which is nothing more than a metal strip carrying one or more porcelain members. The porcelain members are in the form of insulators with a hole through them for holding wires. The metal strips are screwed or nailed to walls, and the wires passed through the porcelain insulators. Thus an electrical installation can be reduced to a simple mechanical job; and the wire-holders are said to cost less, prove stronger, save tire wires and labor, make for a neater piece of work, and turn out to be safer than the usual methods.

Coal and Iron from the Arctic

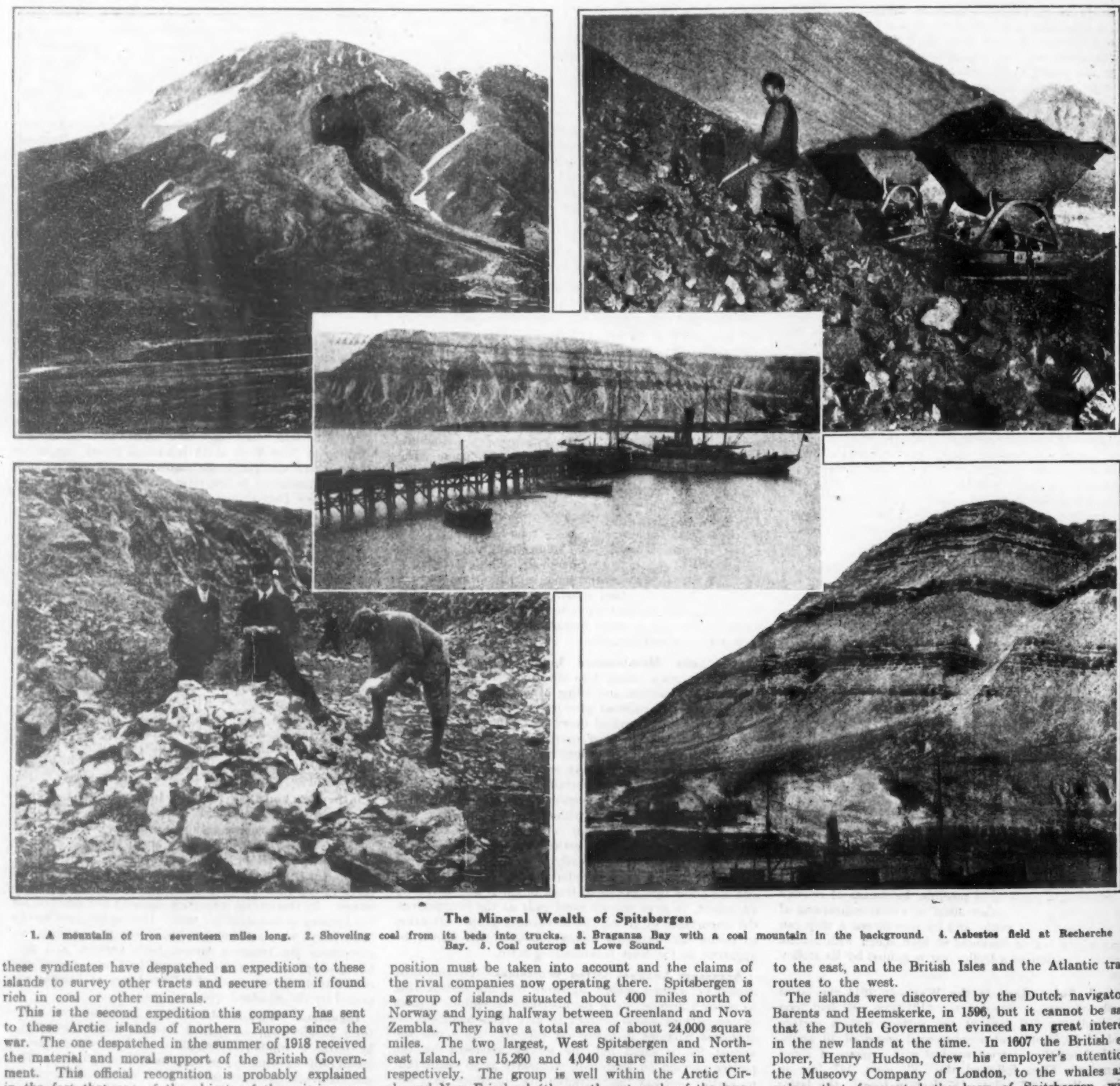
Spitsbergen's Vast Mineral Wealth and the Question of Its Future Government

By Harold J. Shepstone, F.R.G.S.

IT IS a significant fact that while the British Government are worrying over their dwindling coal supply and threatened with demands by the miners likely to make the price almost prohibitive, two powerful British syndicates, controlling 3,800 square miles of coal and mineral lands in the Spitsbergen archipelago, are making strenuous efforts not only to exploit all the coal that is possible from their own extensive fields, but to increase their holdings as well. Indeed, as I write one of these syndicates have despatched an expedition to these islands to survey other tracts and secure them if found rich in coal or other minerals.

This is the second expedition this company has sent to these Arctic islands of northern Europe since the war. The one despatched in the summer of 1918 received the material and moral support of the British Government. This official recognition is probably explained in the fact that one of the objects of the mission was to take over or destroy the wireless station and Zeppelin shed the Germans had erected in these islands. As it is for the most part surface coal that is being produced in Spitsbergen, the syndicates can place it on board ship at a cost of about three dollars a ton, and as their fields are only some twelve hundred miles steaming from British ports, it looks as if they can dump the commodity on to the British market at prices which should secure them a ready sale for all they can supply.

Then quite apart from this aspect of the question, there is the political status of Spitsbergen to be considered. To grasp thoroughly the unique conditions which Spitbergen and its recently discovered mineral wealth—for in addition to coal it is evidently rich in iron ore, while copper ore, oil shale and possibly free oil exist—present to the powers of Europe, its strategical position must be taken into account and the claims of the rival companies now operating there. Spitsbergen is a group of islands situated about 400 miles north of Norway and lying halfway between Greenland and Nova Zembla. They have a total area of about 24,000 square miles. The two largest, West Spitsbergen and North-east Island, are 15,260 and 4,040 square miles in extent respectively. The group is well within the Arctic Circle and New Friesland (the north-east angle of the largest island) is covered by a permanent ice-sheet like that of Greenland, as is also North-east Land, the island adjacent and more to the north. The colder and more distant regions are not too well-mapped and defined, their investigation presenting more difficulties than the country on the long western side. These western shores are washed by the Gulf Stream, which renders them much warmer and much more habitable than other parts of the group. The climate on the west coast is, in fact, a very healthy one, and it is along these coasts and the inland regions adjoining that exploration has chiefly taken place, and it is here that the inception of mining operations has followed. The strategical position of the islands is obvious. Any strong power holding them dominates the Scandinavian peninsula immediately to their south, the approach to the Russian port of Archangel to the east, and the British Isles and the Atlantic trade routes to the west.

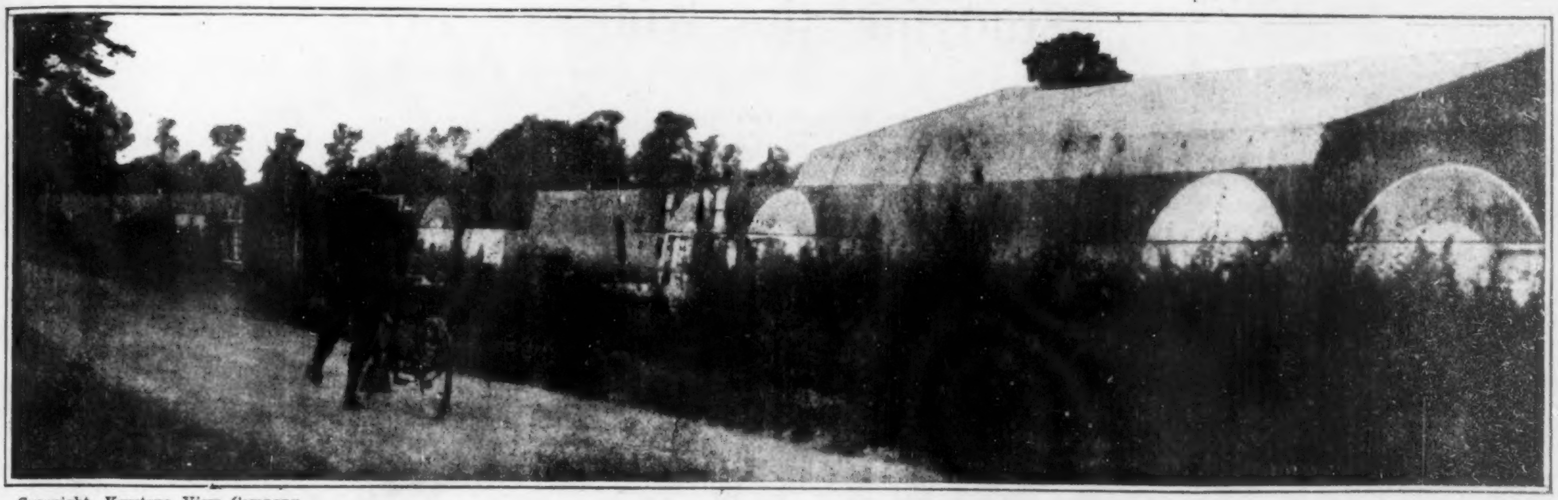


The Mineral Wealth of Spitsbergen

1. A mountain of iron seventeen miles long. 2. Shoveling coal from its beds into trucks. 3. Braganza Bay with a coal mountain in the background. 4. Asbestos field at Recherche Bay. 5. Coal outcrop at Lowe Sound.

The islands were discovered by the Dutch navigators, Barents and Heemskerke, in 1596, but it cannot be said that the Dutch Government evinced any great interest in the new lands at the time. In 1607 the British explorer, Henry Hudson, drew his employer's attention, the Muscovy Company of London, to the whales and walrus that frequented the bays of Spitsbergen, with the result that for nearly half a century whalers from London and from Dutch ports flocked to the shore waters on the north, west, and south coasts of Spitsbergen every summer. Eventually excessive whaling frightened the whales from the inshore waters, and the whalers had to desert the bays for the open-sea fishing.

After this Spitsbergen had a short period of compara-



Copyright, Keystone View Company

This shed and fence are made of discarded airplane wings with their original markings

tive neglect, but early in the eighteenth century Russian trappers appeared on the scene, and for over a hundred years they virtually colonised the country. They used to come in the autumn and spend the winter in rude huts at various places along the coast for the purpose of obtaining the winter skins of bears and foxes. They were eventually driven out by the Norwegians, who remained trapping the game of the country till 1910, when the scarcity of wild life led them to retire.

The whaling and hunting periods may be said to be closed, and Spitsbergen is now entering upon the third

(*Continued on page 376*)

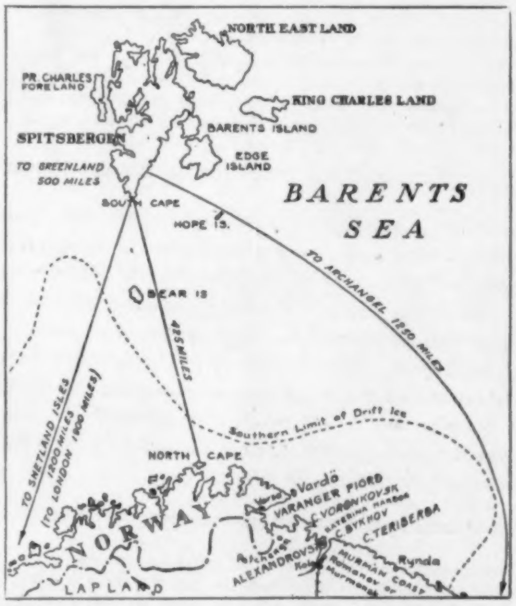
Airplane Wings Turned Into Houses

AIRPLANES are common in Great Britain, just as they are common in the other great countries that took a major part in the recent war. Not only airplanes but parts of airplanes are to be found in abundance, and it is interesting to note what use is being made of these parts and discarded aircraft in general. Automobiles, motor boats, small power plants, and other automotive and power devices are being made from what were once airplane power plants.

It would be difficult to find a more novel application of discarded airplanes than that shown in the above illustration, which shows a shed and a long fence near London, England. It will be noted that the shed and the fence are entirely constructed of airplane wings, with the familiar markings still on them.

Electric Exploration for Buried Water-Pipes

DURING the war, as our readers doubtless will recall, a French scientist developed an apparatus for locating shells buried beneath the surface of the field in which they had struck; and both before the armistice and after, this device was employed to very good effect both in the army and in the service of restoring northern France to a condition where cultivation should be possible again. In the latter application it represented one of the most important peace-time uses for a war-time invention. It now develops, however, that it is susceptible of an even more general utilization, and one which is even more strictly a peace-time activity than is the clearing of old

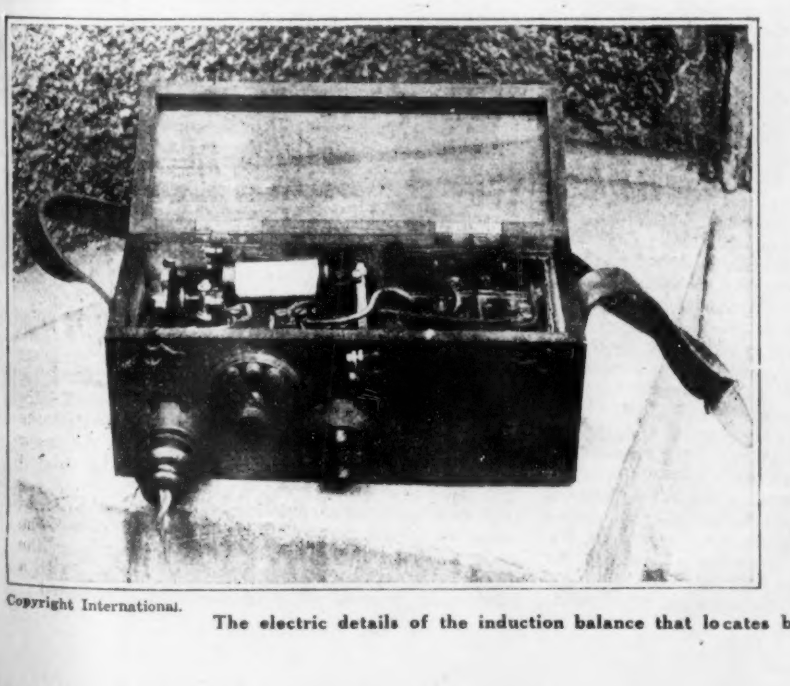


Map showing relation of Spitsbergen to the Arctic coast of Europe

shells from abandoned battlefields. The latter, even though we do it after the war is finished, is really a part of the war—a sort of hang-over from the debauch of destruction; but when we use the electric balance in the business of locating underground water pipes, there can be no doubt that Mars has hung up his sword and turned, if not to the plowshare, at least to something as unwarlike.

The principle of the Hughes induction balance, if not of itself familiar to our readers, has already been explained in connection with the locating of buried shells. In a word, it consists of two induction coils attached to a telephone circuit, and subject to the inductive action of a single alternating current. Obviously, with the two coils identical and affected by this common induction source, the currents induced in both will be exactly equivalent. The coils, however, are so arranged that these equal currents are in opposite sense; so they balance each other off exactly, and there is no effect in the telephone circuit. But, as Hughes, after whom the apparatus is named, discovered, if the coils are brought near an external piece of metal, the induced current in each is modified, and this effect is proportional to a power of the distance from the metal to the respective coils. It is therefore not the same in the two coils; and the telephone at once speaks, recording the fact that the balance has been disturbed and that there is metal in the neighborhood to have effected this disturbance. Then the coils are manipulated about until silence is once more restored in the telephone, after which it is plain enough that the source of the disturbance is to be sought at some point equally distant from the two coils. The loudness of the original noise indicated the distance of the external metal to begin with, so that with the new data of equidistance it is simple enough to locate it exactly.

The installation for hydraulic work is a trifle different from that employed on old battlefields. For one thing, it is more portable, since it is designed with the idea that one man shall be able to carry it on his back while awheel. With this outfit, the exact location of water pipes that antedate careful surveys, or whose position has otherwise become a matter of doubt, is easy to determine; and a good deal of experimental digging in search of them is thus obviated.



Copyright International.

The electric details of the induction balance that locates buried metal, and the manner in which the apparatus is used

Studying the Knocks

How a Closer Knowledge of What Goes on in the Cylinder Might Solve the Problems of the Fuel Supply

By Charles F. Kettering

THE volatility of a fuel is not inherently a measure of its efficiency. But internal combustion fuels must be distributed properly to the cylinders; and the ease with which this may be done depends upon volatility. This property therefore takes on an importance to which its intrinsic value does not entitle it. Until we begin to analyze closely the conditions governing fuel combustion in the cylinder, we shall be disappointed in the results. Mr. Kettering points out that we are dealing with a chemical engine and must bring chemistry to bear in the effort to solve the problems that it brings up; and he gives a number of suggestions as to how this may be done.

THE fuel problem, as it exists to-day, divides itself into two general classes, one of which belongs to the automotive manufacturers and the other belongs to the fuel manufacturers. However, a complete solution in either case is impossible without the hearty coöperation of both industries.

It has been only in the last two or three years that the automotive engineers have been faced with the so-called fuel problem. The gasoline formerly used was of such high volatility as to eliminate this entirely from consideration. The volatility is not to be regarded as an essential or a non-essential of a satisfactory fuel, but it has so happened that in the case of automotive fuels volatility has been, to a certain extent, a measure of the efficiency of a fuel when the difference between the lightest parts of a fuel and the heaviest parts was relatively small.

The motor problem to-day is represented by the devising of such pieces of mechanism as are necessary for a proper distribution of the fuel to the cylinders. Volatile fuels are more easily distributed than fuels which have to be atomized.

In addition to this the motor builders can put in additional temperature controls for holding temperatures of both air and cylinder walls within closer limits.

When all of these things are done we still fall short of getting the result that should be expected, were this problem purely one of mechanical treatment of fuel and mixture.

The internal combustion engine is essentially a chemical device, and, until we begin to analyze the conditions which take place after the fuel starts to burn in the cylinders, we shall be disappointed in the result obtained after the things mentioned previously have been done.

The one important thing in lower gravity fuels is the fact that they give rise to the phenomenon commonly known as the knock. This is sometimes understood to be "prematuring," and is supposed to be brought about by the deposition of carbon in the combustion chamber. It has been conclusively demonstrated and repeatedly checked, that the knock which occurs in a motor is not caused by preignition, but is produced by the nature of the combustion, which, in turn, is controlled entirely by the molecular structure of the fuel.

It is a well-known fact that gravity is in no wise a measure of this knocking phenomenon, as oils from the California crudes of very low gravity give a great deal better satisfaction than a fifty gravity oil refined from Pennsylvania crudes. The reason for this is that in the California crudes there is a large percentage—roughly forty—of the so-called cyclic compounds.

A great deal of work has been done under the writer's supervision during the last three or four years, in the determination of what takes place when the heavier fuels burn in a cylinder, and a few conclusions have been arrived at, which may be briefly expressed as follows:

With lower gravity fuels it has been necessary to lower the compression. Lowering the compression has facilitated the formation of carbon; and carbon, in turn, has aggravated the knock. The reason is simply this: Increasing compression results in higher instantaneous temperatures, and the high instantaneous temperatures result in a type of combustion which makes possible an exceedingly rapid rise in pressure, this rise being of very short duration. Lowering the compression gets away from this, with the result that if the engine is running at low throttle, a precipitation of carbon in the combustion chamber is caused. This deposited carbon forms the best possible type of heat insulator and permits, again, the temperatures of combustion to rise above the critical point, which had been eliminated by reducing the compression.

This discussion is mentioned here for the simple purpose of showing that lowering compression is only a temporary remedy. Lowering compression and increasing the cylinder-bore only decreases the efficiency of the engine and as long as the fuel burns so as to produce these abnormally high pressures, we will have the knock trouble sooner or later.

It has been proved positively that certain things can be added to the fuel which would not necessarily increase its gravity, but which render the engine free from knocks. These additions to the fuel can roughly be divided into two classes—the high percentage class and the low percentage class. By high percentage class we mean from twenty to forty per cent and by low percentage class we mean from one-half to three per cent.

An example of the former is an introduction of benzol. Forty per cent benzol mixed with ordinary commercial kerosene makes an engine operate entirely satisfactorily, and if the engine in which this mixture is used is running at or near its full load, no bad results will be experienced in the way of carbon deposits, etc.

An example of the latter case is that of iodine. One or two per cent of iodine added to ordinary kerosene will reduce its knock-producing property to an entirely negligible point. It will permit the use of high compressions, result in cleaner combustion and, outside of difficulty in starting, make a lower gravity fuel entirely practical.

We understand fully that the use of iodine as a commercial proposition is entirely out of the question, and it is only cited here as an example.

The knock-producing ability of a fuel is not a function of its gravity, as might be gathered from the foregoing, as sulphuric ether, which is one of the lightest fuels that we have, is also one producing the most intense knock.

We have discussed this knock proposition as a preliminary thing so that the matter of the future fuel supplies might be better understood.

As oil men fully understand, about twenty per cent of crude is available as gasoline, twelve per cent as kerosene, approximately fifty per cent as gas and fuel oil, and the remainder as lubricating oil and residue products. A large per cent of gas and fuel oil could be refined into a water white oil and this, were it not for its knocking tendencies as a fuel, is one of the most hopeful sources of increased supply. We also understand the extent to which oils are being cracked into gasoline. It is understood, also, that, if it were possible to cut down into the gas and fuel-oil section, we would have to make certain modifications in the fuel-feeding devices, in order to facilitate the matter of distribution.

It therefore seems to the writer to be of great importance that the oil people, through their processes of refining, should study those things which can be introduced into a fuel to prevent the rapid rises in pressure when certain that lower gravity fuels are burned.

It might be of interest to know that a fuel which will not knock under normal conditions, will not produce abnormal rise in pressure, even though the fuel be fired far in advance of the normal point of ignition. So that a fuel, which would not knock normally, will not knock, even though the engine is heated to the point at which preignition will occur.

It is also definitely understood that the temperature of the cooling water in an engine may or may not greatly effect the temperature of the explosive mixture during the process of combustion, as the thickness of cylinder walls, condition of carbon inside of the cylinders, etc., may be such that the engine, from external appearances, will be running perfectly cool, and yet the conditions inside the cylinders will be such as to bring the temperature of the mixture during combustion above the critical point, at which the knock occurs.

It looks to the writer as though one of the fundamental problems involved in this is a study of the chemistry of the products formed during the process of combustion. As these are in no wise simple reactions, they are rather difficult to determine and experiments intended to discover their nature must be made in a more or less empirical way.

An illustration of the type of combustion which takes place is as follows: If a piece of celluloid be ignited by a cigar, it will entirely decompose without the formation of any flame; if lighted by a match, the phenomenon of inflammability will at once be shown. The celluloid itself is not inflammable, but the gases formed by the decomposition of the celluloid are extremely inflammable. When the celluloid is ignited by a cigar butt the temperature does not rise sufficiently high to cause ignition of the vapors which are formed. When lighted by a match, these two combustions occur simultaneously.

Pressure and temperature have a tremendous effect upon the way in which compounds burn. It is well known that when smokeless powder is lighted in the open air by a match or cigar butt, it will burn without any rapid rise in pressure, but if the products of this primary combustion be confined so that both temperature and pressure rise, the result is quite different and tremendous pressure is developed.

From our experimental work it appears to us that reactions similar to the above take place when we burn the heavier molecules of our present-day fuels, that secondary compounds are produced during combustion, and that the rapid rise in pressure resulting from the combustion of the secondary compounds produce what is known as the knock.

It is the writer's firm conviction that it is possible, as mentioned before, to refine a great deal more of our present crudes into motor fuel and to produce absolutely satisfactory results in engines of very much higher compressions than those now used, if we can control the way in which the fuel molecules break down.—*Read at Automotive Fuel Dinner in New York.*

Grade Crossing Construction

Only a few railroads have yet adopted such excellent substitutes for lumber as asphalt, concrete, macadam, etc., for farm, street and highway crossing construction, although concrete is not a novelty on railroads, as for years past its value and usefulness have been developing. A report from one supervisor's division shows that it required 53,678 feet of lumber, 3,226 pounds of crossing spikes and a labor charge of $5,642.96 to maintain the public and private crossings on his territory for one year, the cost of the plank alone being $1,717.70. If this amount of lumber can be conserved on one division, assuming that it requires 512 feet for one single track crossing, or twice the amount for double track, and assuming also that there are 50 or more highway crossings on each of 3,000 supervisors' divisions on the railways of the country, the use of some other material than lumber would mean the conservation of 76,800,000 feet, amounting to $2,457,600.

Since a crossing must be kept up continually, the method of maintaining it should be so simple as to be grasped readily by the average workman. To be practical, the work should be performed with the least possible equipment and this should be of such character as will always be at hand. To be economical, the expense must be within reason and not exceed that of other methods and materials that are used for work of like nature producing like results.

As far as possible all rail joints should be eliminated in road crossings; good drainage should be installed, and all road crossings in high speed tracks should be made of crushed stone of standard size, mixed either with good road oil, bituminous macadam, asphalt or other good substitutes for lumber. In parts of the country where there is considerable frost and where tracks heave, the sealing of the crossings with these substitutes will keep out the moisture and frost and eliminate the heaving of tracks to a considerable extent, also the heaving of crossing planks, which is a source of danger.

Excellent results have been obtained with crossings constructed of good clean crushed stone (ballast size), from a depth of 2 inches below the bottom of the ties up to the level of the under side of the head of the rail, and extending 2 feet outside the rails, rolling or tamping it thoroughly, the rails having first been painted with hot asphalt below the under side of the head, and a mixture of fine crushed stone and hot asphalt being packed about them for a distance of 8 inches on each side. The entire crossing is then covered with fine stone up to the level of the top of the rails, sprinkling it freely with a good quality of road oil, while fine stone is scattered.

Freaks of War Wireless

How the Phonograph Turned Detective and Solved a Wireless Mystery

JUST before the 64-kilometer retreat of the German armies from the strongly entrenched Chemin des Dames position in 1918, the Allied Intelligence Department informed the General Staff the exact positions which would be evacuated. This was in spite of the fact that all the preliminary operations on the Berlin side were carried out with the utmost attempt at secrecy; that every movement up to the final withdrawal had been made at night; and that even divisional commanders in the German ranks were ignorant of the extent of the retreat. Wireless told the story.

No message telling this precious secret was intercepted. The Germans knew far too much to intrust this to errant ether waves. Yet from the enemy's use of wireless equipment the Allies obtained their positive information.

The reasoning behind it was simple, but it was not until 1918 that either side used the process—perhaps for that very reason. Most communication in the front trenches is carried on by telephone. "Buzzers" chit-chat incessantly. Some of their talk is important. More is merely trench gossip. A little is scarehead stuff calculated to start the foe guessing if he happens to be listening in with microphone.

The trench phone equipment is costly. On the German side toward the end of the war it was likewise irreplaceable. Whenever the decision was reached to get out of a certain sector, the Huns had first to move out their phone instruments, wires and stations. From the time this was started until it was fully accomplished, wireless played an increasingly important part. Every phone station gave place to a temporary wireless station, and the chatter, bluff and serious orders in code were sent in this manner for perhaps ten days previous to the final withdrawal.

From previous experience, French, British and American spotters had become familiar with the coincidental increase in the number of wireless messages with the preparation for retreat. So, with this symptom well developed along a 64-kilometer front on the Chemin des Dames, they had no difficulty in marking off the sector, and even in guessing accurately concerning the time the retreat would begin. Needless to say Allied artillery made the evacuation as difficult as possible.

Another queer situation which arose in the wireless department during the war was known officially for months as the "Nauen-Madrid Buzz." In May, 1916, it appeared for the first time, emanating from Madrid. It was a curious rustle of the spark unlike any message familiar to Allied operators, who of course looked upon it with suspicion and tried to make something out of it. For perhaps five seconds—and sometimes as long as twenty—this peculiar phenomenon would occur. Then no more for perhaps a week. Until Nauen developed the same strange quality the buzz was diagnosed simply as an odd manifestation of "static."

But Nauen buzzed. Immediately all the wireless sharps in the Allied ranks tackled the problem. Though there was no direct proof to hand that Nauen also was not bothered by "static," the coincidence was ugly. So many means whereby the Huns obtained precious information concerning secret military matters had been uncovered already, that the Allies had become quite in the habit of regarding anything out of the ordinary as spy work. The best men were put on the job—and were baffled.

It is needless to detail the many theories which were held concerning this mysterious communication—for after the first weeks no one doubted that the buzzing was just this. The solution was reached through pure accident.

In studying foe wireless—which is in code, if important—the practice is to take down the message on a phonograph record. Then it can be decoded at leisure. One of the many dozens of records of the Nauen-Madrid buzz was being run. A young radio officer was attempting to solve the mystery. The spring in the machine ran down, and as he wearily reached forward to wind the box again he stopped, chilled by the excitement of a discovery. *With the cylinder revolving at a very low rate something that might be a rapid message in code clicked from the horn!*

Throttling down the speed adjuster on the phonograph, he ran the record as slowly as possible. His hunch was justified! There was certainly something there, though it went too fast to be caught.

He wrestled with the problem overnight. Next day he rigged up an electric motor to run his blank cylinder record at a prodigious rate of speed. When the buzzing occurred it was caught. Then when the record was re-run at a moderate rate the message was there! It was decoded shortly, and proved to be part of an important description concerning the disposal of Allied troops.

The secret was simply that at Nauen and Madrid each message was cut into a perforated roll. This was run through the sending apparatus at the speed of four hundred words per minute. Naturally it turned out to be a buzz to anyone not "in the know." At the opposite station they simply took it on the phonograph, and that was all there was to it.

The Allies managed to trace down many spies through the requests made by Nauen. In addition to this a great deal of erroneous information was sent through channels by which it would reach Madrid, and thence Nauen. After this there always was a third party on the line whenever the Germans and their agents in neutral Spain got talking together.

Mineral Wealth in Brazil

The richest mineral zone of Brazil lies in the heart of the Republic, in the State of Minas Geraes. But throughout the central and northwestern provinces there abounds a wealth of gold, silver, iron, manganese, diamonds and other precious stones. At the present time, however, only a small portion of the valuable beds of mineral is being worked. Doubtless existing unsatisfactory mining laws, as well as lack of fuel and transportation facilities, are responsible for this condiiton. Practically the only deposite being exploited at the present time are those of manganese situated near the railroads.

The largest of these is the Mina do Morro, which played a prominent part in American industrial life during the war, large quantities of this mineral being required in the manufacture of steel. Over a road ballasted with the valuable manganese ore, the train bearing the visitor climbs to the top of a mountain of manganese, where the actual process of mining is carried out in the open air. This appears to consist of literally nothing else than the digging or dynamiting off of a hillside and the carting away of the fragments.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Moving Platform for the Vehicular Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

I have been a constant reader of the SCIENTIFIC AMERICAN for over forty years, because my father had read it before me.

Now my four sons take an interest in almost all its articles. We all consider your paper the best medium of any publication we know for acquiring general scientific information. We have perused together your articles in describing a double-deck tunnel for individual vehicular traffic under the Hudson, between New York and New Jersey.

This tunnel is certainly wanted at once—to avoid the annoying delays of the present antiquated ferry system. Living in Montreal we are familiar with cement lining for tunnels and it has given satisfaction there.

You have devoted a great deal of space to considering how to get rid, in the proposed tunnel, of the carbon monoxide gas emitted by the motor trucks and high speed automobiles. Among other things, you discuss the advisability of introducing, in the conduits on each side of the tunnel, air currents of high velocity (160 miles an hour is mentioned) so as to drive out and mix the carbon monoxide with so large a quantity of pure air as to render it inoffensive. The cost to supply air at this velocity and in such quantity would be considerable.

It would almost seem that if air at this velocity or perhaps at a lower one was let loose in the direction of the traffic, it would be quite sufficient to blow through the tunnel all vehicles without other power, the driver having only to steer and apply the brakes to regulate the speed. But speaking seriously, would a moving floor on each deck not be exactly what is wanted? It would be like an endless chain going west towards New Jersey and east towards New York. It is for competent engineers to calculate how much more power, if any, it would require to propel this moving floor loaded with traffic, than to blow air through the tunnel at 160 miles an hour. If it was found that difference in cost was not too great, there would be an immense advantage in the moving floor system. All engines being shut off there would be no possibility of accidents or collisions. This moving floor could be driven at a comparatively high speed. It is superfluous to say that differential-speed moving floors would be installed at both ends so that the vehicles would gradually approach the high-speed space without any great jar.

It is also evident that on the lower deck, the differential-speed moving floors would have to pour in the traffic from the sides.

It is a question whether the present space allowed on the left side of each deck for vehicles drawn by horses should remain, or whether it would be possible to let the horses stand and rest with their load, whilst being carried under the Hudson by the moving floor.

There would be saving in gasoline and in horse power. This ought to offset in a measure any extra cost in power for moving this floor.

J. P. B. CASGRAIN.

Ottawa, Canada.

To the Editor of the SCIENTIFIC AMERICAN:

In the discussion on a vehicular tunnel under the Hudson River, one of the chief difficulties seems to be the large amount of ventilation required on account of the monoxide gas in the exhaust of the automobile engines.

One way to solve this difficulty would be to provide moving platforms or conveyors through the closed part of the tunnel for the passenger and truck automobiles and requiring them to stop their engines, thus doing away with the injurious gases entirely. The minimum amount of ventilation required would then be partly furnished by the traffic itself.

Another advantage of the conveyor system would be the larger amount of traffic possible during the rush hours. A conveyor for passenger automobiles running 15 miles per hour with five cars per hundred feet, would carry 2,340 cars per hour. The conveyor for the trucks running 8 miles per hour with four trucks per hundred feet would carry 1,664 trucks per hour. A line of horse vehicles under their own power to move four miles per hour with five vehicles per hundred feet would be 1,040 per hour. Making a total of 5,044 vehicles per hour in one direction and 10,088 per hour for both directions.

This system should be operated with approximately one-fourth the horse-power (17,000 horse-power) quoted in your March 8 issue for ventilation alone.

The conveyor system would also reduce collisions to a minimum.

CHAS. N. TOUSLEY.

Limo, O.

Origin of Racial Differences

Assuming that the various existing races of mankind are descended from a common stock, how are we to explain such striking differences as those that distinguish, for example, the Chinaman from the Anglo-Saxon, and the Anglo-Saxon from the negro? Prof. Arthur Keith discussed this question in his presidential address before the anthropolgical section of the British Association at the recent Bournemouth meeting.

He believes that the key to this problem is to be found through studying the disturbances and disorders that occasionally affect the development and growth of the human body; especially those due to a functional derangement of one or more of the glands of internal secretion—the pituitary, thyroid, pineal, adrenal and genital glands. In some manner not yet understood, the functions carried on in these glands regulate not only the dimensions of the body but also the shape and size of each individual part.

The racial features of the Mongolian type are imitated by growing Europeans who are affected by deficiency disorders of the thyroid gland. The features of the negro can best be accounted for by the nature of the growth-regulating mechanism centered in the thyroid and suprarenal glands. European features are connected with a dominance in the functions of the pituitary. To these interesting suggestions of Prof. Keith's we should like to add that a thorough study of the still very obscure subject of the so-called "ductless" glands may not only throw light upon the mechanism of organic evolution but also provide the means of regulating, to some extent, the future evolution of our race.

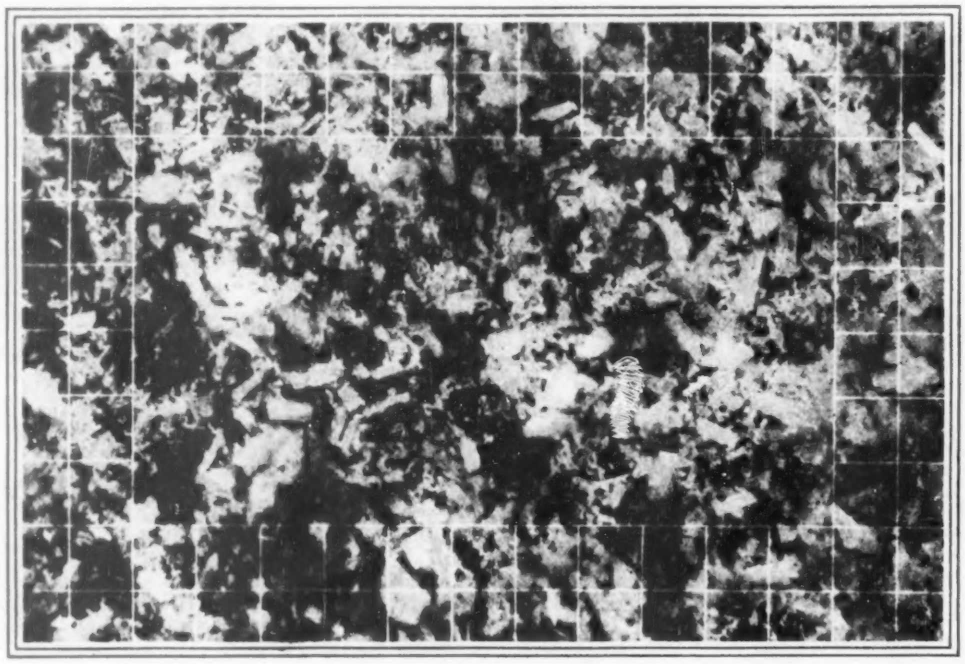
Munitions of Peace

How the Deadly T.N.T. Can Be Put on Its Good Behavior and Made to Work for Its Living

By C. H. Claudy

THE world is but beginning to make use of its war-developed ideas for peace-time pursuits. It was the war impetus to aviation which made transoceanic flights possible. The war developed the radio telephone to a practical basis. It was war which showed this nation how to build ships and build them quickly. It was the effect of the war which produced a revolution of trade practices and convinced even ardent trades unionists that the artificial restrictions of apprenticeship measured in years where months would do, was a mistake—though perhaps this realization came more in England than in this country.

It is one of the pleasant functions of peace to make use of the developments of the art of war, but it is seldom that peace can use the material of war. Peace hath no use for great guns, nor for shells, nor for armies, nor even for submarines. But peace may use the very tool of tools of war itself, if only peace will believe it. The adaptation of TNT the terrible to peaceful work is one of the oddities of the aftermath of the great conflict.



A mass of TNT magnified ten diameters to show its structure. The square markings, one centimeter each way as here shown, represent a square millimeter in the original

TNT—short for tri-nitro-toluol—came into public notice only with the great war, although it has been known as an explosive since the Civil War, at least in the laboratory. But it remained for the great conflict to bring it into prominence, which was done because it offered an unusual degree of safety to the user, plus an efficiency as a bursting charge for high explosive shell, depth bombs, mines, torpedoes and similar devices slightly greater than that of other well-known explosives.

The reader may be surprised to hear TNT spoken of as a "safe" explosive. During the war there were, it is true, many disastrous explosions in both the manufacture and transportation, even in the quiet storage, of TNT. But the explosions were due to the hurry and carelessness of speed and emergency, not to inherent lack of safety in the explosive. Had, for instance, dynamite or plain nitroglycerine been similarly handled, there is small doubt that the unfortunate explosions would have been vastly greater in number. Neither nitro-glycerine, dynamite or gun-cotton will stand what TNT will stand, which is the best reason in the world why this most terrible of war's weapons should find a secure place for itself in the uses of peace.

But its industrial use is new and almost untried, and because of the name of terror it acquired during the war, many who would handle the familiar dynamite of the mine, the blast, the quarry, the tree stump, the log split or the ditch-digging operation fearlessly, shrink from TNT. That they shrink without real cause has been demonstrated by careful and exhaustive tests conducted by the Bureau of Mines, which has shown that it may not only be employed with greater safety but with greater effect than the familiar explosives of industrial use.

Without going very deeply into the chemistry of the substance it may yet be interesting to consider it for a moment as a substance rather than as an explosive. TNT is produced by the action of nitric acid upon toluene in the presence of sulphuric acid. Toluene is a soft-coal product, obtained as a by-product in the manufacturing of coke, coal gas, and coal tar. There are many nitrotoluenes, hence the distinguishing of this particular one by the "tri" which indicates its chemical composition.

It appears as a pale yellow crystalline substance which darkens to a deeper yellow and a brown under the action of light. It is very slightly soluble in water, melts at about 177.9 degrees Fahrenheit, and can be cast, like any molten metal, when so melted, or dropped into water and solified in globules or pellets. The TNT allotted to the Interior Department by the War Department from its large war-provided store, for allocation to peace uses by various Government activities, such as the Office of Public Roads, the Reclamation Service, the Indian Office, etc., is in three grades, differing in the temperature at which it solidifies, and in purity. Pure TNT has a faint odor, tastes bitter, something like quinine without the permeability of that chemical on the mucous membrane, and is to some extent poisonous, though not fatally so without large quantities or great exposure. Nitro-glycerine is so powerful a heart stimulant as to find a place in *materia medica,* and, as is well known, produces severe headaches when allowed to come in contact with the person. TNT requires a much longer exposure to produce its characteristic effect—a rash or skin breaking-out—and can be handled without danger if gloves are worn and it is not allowed to touch mouth, nose or eyes.

TNT needs a more powerful detonator than either nitro-glycerine or dynamite. The statement that the extra powerful detonation required for TNT means increased expense for use is hardly borne out by the facts. A couple of pennies covers the extra charge (no pun is intended) with something to spare.

TNT is not so sensitive to friction as 40-per-cent straight dynamite (the familiar explosive of blasting operations), gelatin dynamite or even picric acid. It is less sensitive to percussion than the dynamite and several other well known explosives. It may be fired and burn peacefully, but it may be fired and turn its flame to a detonation, so it cannot be said to be fire proof. The results of the explosion of TNT are six different gases: carbon dioxide, oxygen, carbon monoxide, hydrogen, methane and nitrogen. The proportion of the poisonous gases produced is about forty-six to fifty-four of the non-poisonous. Forty-six per cent of poisonous gas as a result of an explosion is too much to permit the explosive so resulting being used safely in confined or underground work, unless ventilation is very good or plenty of time can be permitted to allow the poisonous vapors to dissipate.

The efficiency of TNT compared to other similar explosives is high. The Bureau of Mines determines relative efficiencies by comparing what is termed the "unit deflective charge" and the "rate of detonation." The first is defined as "that weight of an explosive which will swing the ballistic pendulum the same distance as one half pound 40-per-cent straight nitro-glycerine dynamite." In other words, the less the unit deflective charge, the greater is the propulsive capacity of the explosive. Different grades of TNT give results varying from 109 to 114 as compared with 100 for 40-per-cent dynamite.

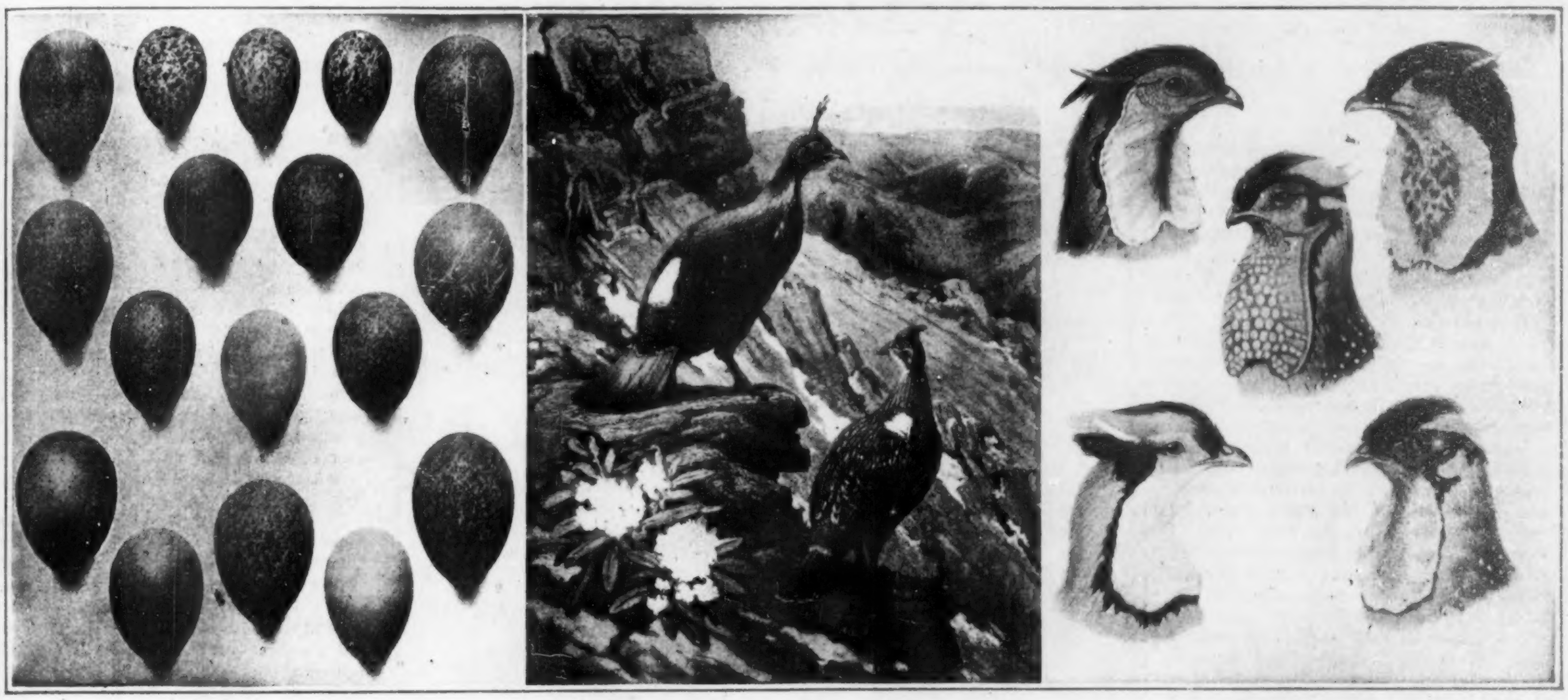
"Rate of detonation" is a measure of the ability of an explosive to disrupt or shatter material in which it is exploded. In other words, it is not only the amount of force exerted which counts in an explosive, but time during which it acts. A very homely example will make this clear. Supposing a piano weighing a thousand pounds requires a push of 100 pounds to start it rolling across the floor. If a man push slowly until he exerts that required hundred-pound rolling pressure, the piano will move. But if he hit it with a ten pound sledge hammer, with a sufficient force to exert a pressure of one hundred pounds on the end, he will not move the instrument but shatter the wooden end of it.

Result of two-pound TNT blast on 18-inch oak stump

It is so with an explosive. It is not only the unit deflective charge which is of use, but the rate at which that developed pressure takes effect. In blowing up a boulder of rock, a slow explosive may exert plenty of pressure and move the rock, while another, with half the pressure, but much more suddenly applied, may not succeed in moving the mass as a mass at all, but will shatter it to fragments.

Rate of detonation is measured in meters per second, and with 40-per-cent dynamite on a scale of 100 TNT grades from 94 to 102, according to quality. The rate of detonation of 40-per-cent dynamite is about 4,772 meters per second, and TNT varies from 4,482 to 4,852 meters per second—approximately the same.

It is the shattering effect which made TNT depth bombs so valuable in anti-submarine warfare. Several times as much gunpowder, for instance, in an ordinary "depth bomb," would, if exploded in the same position, do much less damage. It is the tremendous shattering effect of detonating compounds, such, for instance, as



Some of the world's little-known pheasants

Left: Eggs of blood partridges, tragopans, impeyans and blood pheasants. *Center:* The Himalayan imp eyan, a pheasant of rare beauty. *Right:* Wattles of typical cock tragopans.

fulminate of mercury, which makes them valuable in setting off other explosives which have to be heavily jarred to explode.

TNT resists dampness very well and therefore can be used in damp holes, with proper precautions not to break cartridge cases. When exploded, TNT gives off dense volumes of black smoke.

It may be interesting, as giving an idea of the real power of such "high" explosives as are here under consideration, to notice for a moment the results of what is known as the Trauzl block tests. Cavities are made in blocks of lead and various explosives set off within these cavities. The increase of volume in the size of the cavity of a substance like lead, which stretches with great resistance without shattering, is a measure of the force of the explosive, and on a basis of comparison, enables the chemist to determine the relative efficiencies of the various compounds tested.

Forty-per-cent straight dynamite is here as elsewhere the comparison standard. Fifty-per-cent dynamite rates 105.2, granulated TNT 113.1, 60-per-cent straight dynamite 120.2 and blasting gelatine 149.8. At the other end of the scale is black blasting powder, 10.5 with 40-per-cent gelatine dynamite 73 and the same percentage ammonia dynamite 75.5.

Summing up, TNT has proved itself a very tame servant; the beast of war has become the burden bearer of peace. For shooting up boulders, digging ditches, removing stumps, splitting logs and similar work it is fully as tractable, every bit as safe and entirely as efficient as 40-per-cent straight dynamite. It gives complete detonation if properly handled, detonates as completely under water, and can stand moderate immersion in wet holes. It is less sensitive than the dynamite and is therefore as safe or safer to handle.

And this, if you please, is TNT the terrible!

The Pheasants and Their Book

By Lee S. Crandall, Curator of Birds, New York Zoological Park

OF all wild birds, probably none make a broader appeal to mankind than the pheasants. The *Phasianus* group, of which the common ring-neck is typical, is gradually taking the places of our diminishing native game birds. The rarer species appeal to the agriculturist because of the ease with which they adapt themselves to the conditions of captivity and to the layman because of their wonderful coloration.

There has been much discussion of the advisability of introducing the ring-neck into our coverts. Many sportsmen feel that nothing can ever replace the bobwhite and the ruffed grouse, and that more attention should be given to these vanishing species than to doubtful foreigners. With this feeling there is widespread sympathy. Even the men who have been instrumental in pushing the ring-neck are among the staunchest friends of our own birds. But the conditions which have brought about the decrease in numbers of the bobwhite and ruffed grouse, will continue to operate against them, and it is probable that nothing short of stringent shooting restrictions will save them from actual extermination. Both species are propagated with difficulty, at least in any numbers sufficient to be of value in restocking. Some advance has been made with the bobwhite, but grouse of all kinds are notoriously hard to breed in captivity and there is little to be hoped for from this source.

On the other hand, the ring-neck is a vigorous, hardy bird, well able to look after itself under all conditions where life is at all possible. The English ring-neck has been bred in captivity for centuries and may be considered as practically domesticated. Its needs are thoroughly known and the methods of propagation have been worked out to an exact system, which can be applied to rearing on a large scale.

The English ring-neck, commonly used by American breeders, is a hybrid between the Chinese ring-neck, originally brought to England, and the English or black-necked pheasant, a native of Asia Minor, introduced at a later date. In most of the modern birds, the characters of both species are plainly evident. This pheasant is of large size and tractable disposition, so that it is particularly suited for its purpose. So long as it is bred in captivity and liberated yearly in sufficient numbers, it will always provide good sport for those who seek it with gun and dog. Under favorable conditions, there seems to be no doubt that the bird is even able to establish itself in a wild state and, if not unduly molested, may be found in good numbers.

A Chinese pheasant hunter and his muzzle-loading gun

However, the English ring-neck has been so long in captivity that much of its native ability to shift for itself has been lost. On our western coast, notably in Oregon, the pure Chinese ring-neck has been introduced with great success. This bird is smaller than the hybrid and retains enough of its wildness to enable it to care for itself more efficiently. Eastern farms are beginning to cultivate this bird and it is entirely possible that some day we may find the Chinese ring-neck firmly established as a self-sustaining citizen.

State game farms, notably those of New York, New Jersey, Massachusetts and Oregon, have rendered a great service to the sportsman, in yearly rearing and liberating many thousands of game pheasants. Numerous private farms are now being operated on a commercial basis, with excellent result.

Outside the ring-neck group, there seem to be no pheasants with sporting possibilities. At least, this is true under our conditions, although in their native wilds, few birds are harder to shoot. The value of these birds to mankind is chiefly esthetic. The brilliant colorings and intricate patterns of many of the species, make them a constant marvel and delight. Throughout Europe and America, may be found countless aviaries, devoted to these splendid birds, which are kept for no other reason than their ornamental value.

Of these aviary pheasants, there are more than seventy species, although not more than thirty are usually to be found in captivity. They are all of Old World origin, the center of distribution lying in northern India and China. Most come from localities where low temperatures prevail, so that in captivity they are able to endure great cold without discomfort.

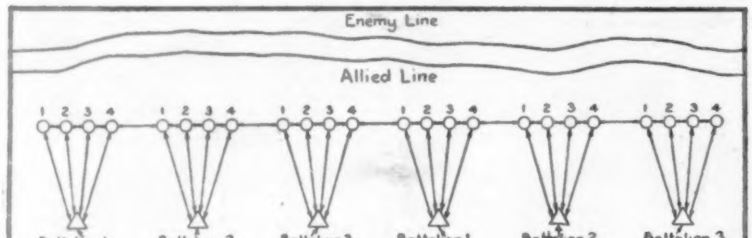
Among them, there is the greatest range of form and color. The tragopan cocks are chiefly red, variously mottled with other colors. They have no feathers of ornamental form, but during the mating season, display two colored "horns" and a wonderful bib of brilliantly colored skin. The closely-allied Impeyan is probably the most glittering of all, since his feathers are highly iridescent and reflect all the colors of the spectrum. Then we have the kalij group, of which the silver pheasant is a well-known example. The golden and Lady Amherst, both natives of China, possess decorative form as well as startling color and moreover, are among the easiest to propagate in captivity. The bar-tailed pheasants include the Reeves, mikado, Elliott, Hume and Spemmer-

(Continued on page 380)

A Loop of Wire

An Interesting Radio Communication Development That Resulted from the Great War

By Walter J. Henry



How the American Army units communicate by radio loop sets

ONE of the most interesting developments in radio communication brought forth by the war emergency was the Priess loop set. This instrument solved the problem of front line communication for the American Expeditionary Forces. It was developed in France and gave a reliable shell-proof communication system that would link our advancing troops with their battalion and regimental posts of command. It would likewise locate geographically, with extreme accuracy, the position of "lost" troops equipped with a similar set.

Warfare about the middle of June, 1918, passed through a rapid change from the trench stalemate to the open field struggle. The shelter and security of the trench were abandoned for the final trial of strength between the giant armies. The telegraph wire that had long been protected by the trench system followed the troops into the open country. One such wire at Soissons, 1,000 yards long, suffered 350 shell breaks during a single barrage. Telegraph wires forward of regiment were impossible to maintain. One amusing case was that of the signal officer who laid eight lines between two points to insure the working of at least one line. Just as the engagement was developing a tank zig-zagged ponderously across the field, pulled up the eight lines and ground them into a hopeless mass of tangled copper and shredded insulation. Resort was made to runners. The terrific loss of life involved and the uncertainty of delivery and check of the messages made this method highly undesirable. It became the joking comment among the Signal Corps men that only field wire and men were "expendable."

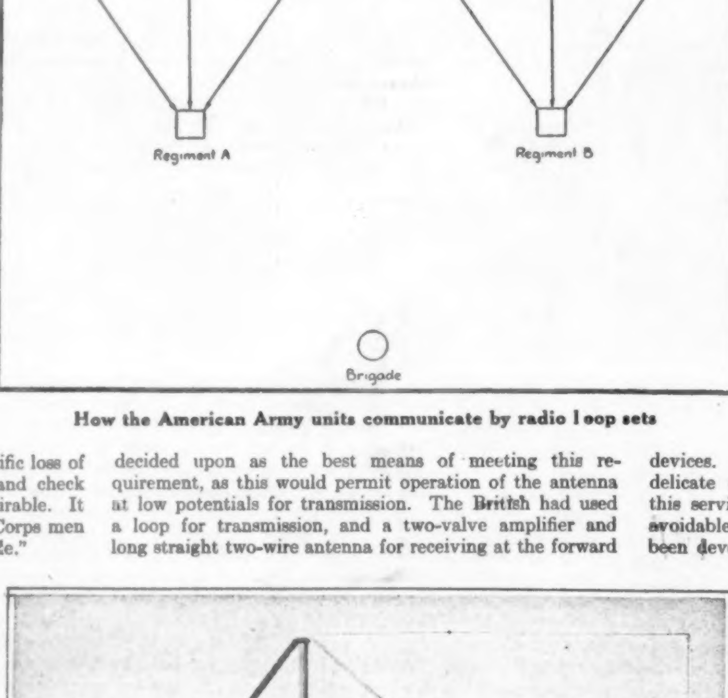
Incidents of this kind soon made it painfully evident that the ground telegraphy communication system must be quickly abandoned in favor of a system based upon compact, portable and shell-proof radio sets. The radio communication system interlinking Brigade, Division, Army Corps, and Army Headquarters, had already reached a highly efficient basis on which information was regularly transmitted by serviceable equipment on well organized wavelength schedules. This system was based upon undamped transmission using receivers of high amplification. The apparatus was the regular French Army equipment built by the French Signal Corps under the very able direction of Colonel Ferrie and his associates.

The front-line communication problem was placed before the research organization of the A. E. F. which was maintained for the express purpose of grasping the shifting problems of warfare communication and developing the working solutions. This organization comprised a small number of very able officers, each a specialist in his line. These officers, with their intimate knowledge of front-line conditions, and backed by the valuable assistance and years of modern warfare experience of the French Signal Corps, solved the communication problems of the A. E. F.

Under the supervision of Lieut. William H. Priess, formerly Expert Radio Aide at the Washington Navy Yard, came all field radio forward of brigade. Lieut. Priess started work in June on the development of a front-line communication system that would again establish the liaison that had been broken by the change in the methods of warfare. He proposed to design a set that could be carried as a one-man sized load, and be capable of being completely contained within the shelter of a dugout or other small geographical variation, such as a shell hole. This limited the height of the antenna system to approximately 4 feet. Taking the lead opened by the British Signal Corps a loop, one meter square, was decided upon as the best means of meeting this requirement, as this would permit operation of the antenna at low potentials for transmission. The British had used a loop for transmission, and a two-valve amplifier and long straight two-wire antenna for receiving at the forward stations. In addition, they had used an elevated antenna system for both transmission and reception with a two-step amplifier on the receiver at the rear station. The range of the British equipment was about 1600 yards. This system was further complicated by the use of four entirely different units for each wavelength.

Lieut. Priess decided to conduct the research along the line that would produce a single set capable of two-way communication on three wavelengths, and using the same loop for both transmission and reception. He likewise decided to attempt a solution that would use a minimum of storage battery power on the receiving setting since all stations are normally on this setting.

Lieut. Priess invented an entirely new type of receiver which would permit the accurate and easy reception of undamped waves of a frequency of 6,000,000 per second. Because of the additional experimental work required on this apparatus and the proven reliability of spark transmitting apparatus, as well as the urgent need of front-line equipment, he decided to use damped transmission. Quenched spark transmitters are inherently rugged, highly efficient and required comparatively little training for their operation. Likewise the troops arriving from the United States had received training in spark equipment and were unfamiliar with tube transmitting devices. In addition, the power transmitting tube was delicate and unable to withstand the jars incident to this service. This decision eliminated an otherwise unavoidable delay. On June 14th a working solution had been developed and a report on this equipment was sent back to the United States.



Radio loop set developed for the use of front line troops

The first loop sets built were tested at Chatillons. The tests were made between two such sets above ground and five kilometers apart. The tests brought out the following points:

1. The receiver oriented over the wavelength range as well as could be expected of an unbalanced loop. 2. The audibility for equal battery inputs was approximately constant between 100 to 180 meters, fell off slowly to about 80 meters, and fell off much more rapidly to 66 meters, the shortest wavelength tested. 3. The operation of the receiver increased in stability with increasing wavelength. 4. With the receiver loop parallel to the ground and resting on it stability occurred. This disappeared entirely on raising the loop a few inches off the ground. 5. The audibility remained constant for rotation of either the transmitter or the receiver loop about an axis passing perpendicularly to the plane of the loops and through their centers.

The next test was carried out with the transmitting loop in a dugout and the receiving set five kilometers away and above ground. The dugout consisted of an arched stone chamber seven feet wide, seven feet high, and fifteen feet long, closed completely at the entrance by an iron gate. About ten feet of earth and stone lay between the roof of the chamber and the open air. Excellent communication was obtained.

The receiving loop was then placed in a dugout similar to the above, and 400 yards from it. Good signals were obtained with a fraction of the transmitting energy available with the doors of both dugouts closed. Both loops oriented sharply. General E. Russell, Chief Signal Officer of the A. E. F., became interested in this new development and pushed the construction of two models to be taken to the front for trial. The necessary parts for this set were salvaged from the various radio equipmens available, and new parts were made

(Continued on page 380)

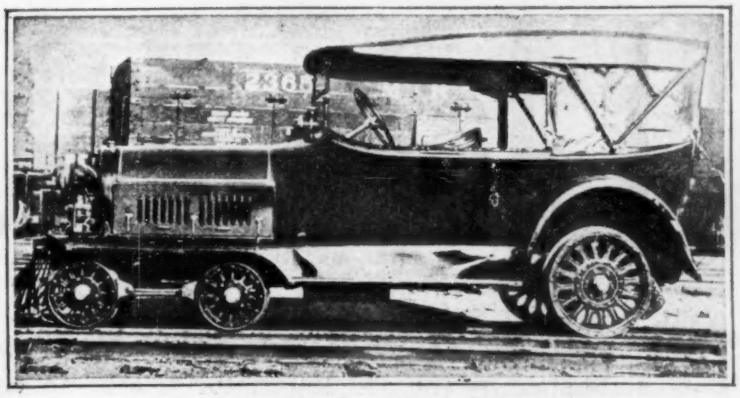
The Railroading Automobile

RAILROAD officials, from the dawn of rail history, have travelled over the line in private cars, hauled by locomotives, and ballasted by a baggage car full of stone or iron or something of the sort. A decided variant on this practice, and we should hardly hesitate to say a decided improvement over it, is represented by the railroading automobile shown on this page and on our cover. In this vehicle the construction superintendent or any other person in authority can make short excursions up and down the line with a convenience and at a low cost never approached by the more traditional railroad equipment.

The automobile in question is a touring car of generous proportions. It has not been considered sufficient to replace the rubber tires by steel flanges to take the rails, as has been done from time to time when it was desired to have an automobile travel over the right of way—on the pioneer transcontinental tour, for instance, when it will be recalled that an automobile was thus fitted with flanged wheels and permitted to go about the country on the rails, subject to despatcher's orders just like a regular train. In the present case the entire front axle has been removed and replaced by a pony truck of the sort that supports the extreme front of the conventional locomotive. The rear underbody of the automobile has been treated with somewhat less severity; here new wheels have been put on the regular automotive axle—wheels that in general structure represent a compromise between railroad and road practice, but which of course must carry the flange of the railroad wheel.

In other respects this outfit conforms to good railroad traditions. It carries a "cowcatcher," for instance, if we may descend to the use of this term. Front lights and rear lights conform to the railroad practice, of course. Naturally, with the modification of the wheel surface, the bearing surface of the brakes had to be altered; and advantage was taken of this necessity to install a much larger shoe than the ordinary touring car would carry. This of course is necessary in view of the much reduced traction resistance offered by the rail, as compared with the paved surface over which the automobile customarily travels.

In this car the railroad boss, whatever his capacity or his connections—whether he be boss of section gang, superintendent of construction of a large extension, or even so mighty a potentate as the "G. M."—can pass about over the lines on tours of inspection more pleasantly, more conveniently, more cheaply, and with far less disorganization of regular business. And since the car is a seven-passenger one, it can be made the medium for taking quite a party over the line.



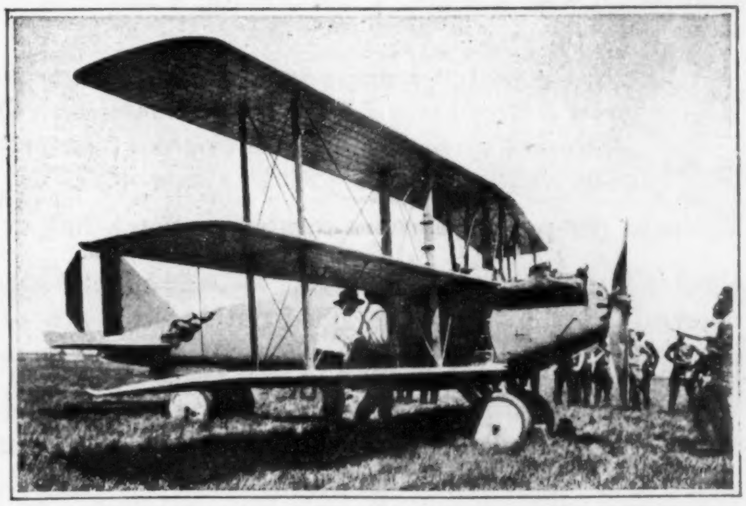
Automobile for railroad officials

Curtiss Triplane Wins Altitude Record

THE first notable airplane meet to be held in America was that which took place at Belmont Park, Long Island, in the Fall of 1910. Representatives of the best makes of machines, domestic and foreign, were present, and they were piloted by the most noted flyers of the day. Those of us who were there will recall the breathless interest with which we saw the vaarious machines sweep around the course at 60 miles per hour or climb several thousand feet into the air. The fastest machine shown, if we remember rightly, was the monoplane, and the best climber was the biplane.

If the announcer of those feats of speed and air-climbing had ventured to predict that within a decade the speed would be increased by 100 miles per hour, and that the altitude attained here would be quadrupled—well, most of us would have given him credit for more enthusiasm than common sense.

Nevertheless it is a fact that we possess in this country a machine which last year, under most careful measurement and timing, made a speed with full military load of 163 miles per hour, and which on September 18th performed the amazing feat of reaching an altitude of 34,610 feet. The first performance is, so far as we know, a record is nearly 1,500 feet better than the previous unofficial record of 33,137 feet, made last May, by Adjutant Casale of the French Army.



Curtiss "wasp," a triplane, with a 400-horse-power engine, which made the record altitude flight of 34,610 feet

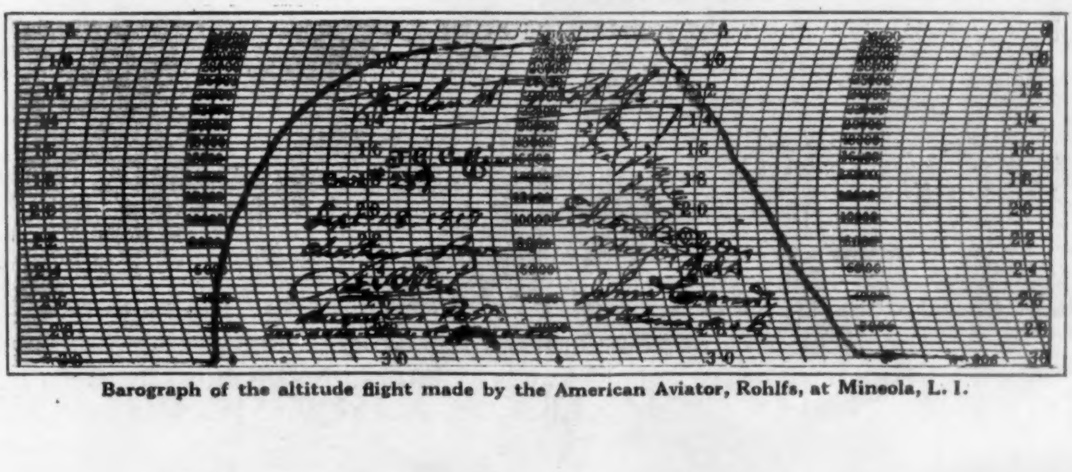
The ascent was made at Roosevelt Field, Mineola, under favorable weather conditions, the wind at the ground being light and the sky clear. A few days previously the pilot, Roland Rohlfs, had driven the same machine to a height of 34,200 feet in an unofficial test. The trial of September 18th was official. It was witnessed by a committee of the Aero Club of America, and by Col. John D. Carmody, in command at Roosevelt Field, Major Lyons, in charge of flying at the nearby Mitchel Field, and Major Henry F. Miller.

The start was made at 12.06 o'clock and it took 78 minutes to reach the peak of the ascent, where the thermometer showed a temperature of 43 degrees below zero. Trouble began, says Rohlfs, at 20,000 feet, when he began to inhale from his supply of oxygen through the nose and mouth, and found that it was producing an irritating dryness of the throat. Thereafter he inhaled through the nose alone. At 31,000 feet the plane "wobbled" and dropped about 600 feet (see barograph record). Thereupon he put on more power and continued to climb slowly. He landed about 20 feet from his ::takeoff." It should be mentioned that the first 10,000 feet was made in eight minutes. The next day in a special climbing test the machine reached an altitude of 19,750 ft. in 9 mins. 42 3/5 seconds.

We present a photographic reproduction of the official barograph record, which was sealed and sent to the Bureau of Standards, Washington, where it will be tested and the final official result declared.

The machine, known as the Wasp, which achieved this remarkable feat is a triplane driven by a 12-cylinder Curtiss motor. It was built by the Curtiss Engineering Corporation at their Garden City plant, and it embodies the results obtained by an elaborate series of tests in the large wind tunnel with which the plant is equipped. The great speed and climbing qualities of the machine are due in great part to the special sections of the planes, to the careful streamlining, and to the light weight of the machine in proportion to its power.

The motor, a "production motor," weighs 728 pounds and of 400 H.P. works out at 1.82 pounds per horse-power per hour. The plane complete weighs 2,750 pounds.



Barograph of the altitude flight made by the American Aviator, Rohlfs, at Mineola, L. I.

The Sub Chaser

When the United States entered the war it was, as were all the Allied nations, very short of small craft. The need for such vessels was very great. Miles of ocean waterways and coasts were to be protected from the submarine and only a few yachts and other small boats were on hand for such service.

A ship was needed that would be especially effective against the submarine and the Navy Department set about to design such a craft. The well known submarine chaser was the result. It was designed to be built from standardized parts and was constructed as rapidly as possible. In planning the ships the Navy Department hoped to fit them with two 300-horse-power slow-turning engines to give a speed of 18 knots. Here the first snag was struck. No such engine was on the market and it would take months, possibly a year to build one. The urgency was not a matter of months or a year but was immediate and commanding, and the Department was forced to make a second choice. In order to get a ship of somewhere near the desired speed it was decided to fit the chasers with three 200-horse-power heavy duty gasoline engines, a small 8-horse-power engine being added to the equipment for auxiliary purposes. The chasers are 110 feet long and the designed armament is one short 3-inch gun.

When the first of these ships had been completed in the Brooklyn Navy Yard, the Naval Constructors, after a careful study of the boats, decided that their keels were too straight to allow them to turn so quickly and easily as they should. The draught foreward and some of the deadwood aft were cut away leaving the ships much more handy in a sea way. Too much has been expected of these little 110-foot boats. They are not, nor were they intended to be, trans-Atlantic ships, However, many have crossed the ocean under their own power; a remarkable feat.

As a matter of fairness to their adverse critics, one must admit that four engines clutter up an engine room and this does not make for efficiency. The ships are somewhat faulty at sea and were soon relegated to inshore work only. On the 6th of August, 1917, the Secretary of the Navy announced that no more contracts for these boats would be given. During the war the United States constructed about 375 of them.

The design of these ships is very crude, as the plans were drawn to make fabrication as simple as possible.

BUILDERS of

The 500,000 motor trucks in America have a yearly performance record of fifteen billion ton-miles.

FIFTEEN BILLION TON-MILES a year is the performance record established by the 500,000 motor trucks in use in America today. The motor truck has become a tremendous factor in the world's existence. The importance of its development ranks with that of the locomotive, the steamship, the trolley car, the telephone and the telegraph. On it depends the further increase of business that has reached the profitable limits of its expansion. A case in point is that of the Milwaukee Electric Railway and Light Company, which issued the following statement:

Railroads adopt motor trucks to extend terminal facilities.

"Using motor trucks, we have extended our interurban fast express service beyond Watertown to Johnson's Creek, Jefferson and Ft. Atkinson, three of Wisconsin's richest food-producing communities."

Twice in the past five years the motor truck has averted world wide calamity.

First—Through the part played by motor transportation the world war was determined in favor of the allied nations.

Twice the motor truck averted international catastrophe.

Second—When, due to insufficient equipment and terminal facilities, our railways failed to function adequately, the motor truck again prevented national and international catastrophe. In emergencies it is indispensable.

For emergency transportation the motor truck is indispensable.

Because of railway congestion, the Service Motor Truck Company experienced a delay in securing axles that threatened a serious curtailment of production. Motor Truck Trains solved the problem by making regular runs from Detroit to the factory at Wabash, Ind., carrying axles, in one-fifth the time formerly consumed by rail transportation.

The relief of the present alarming shortage of food supplies throughout the world is dependent absolutely upon the prompt extension of truck express lines to the remotest sources of supply in America. For the shortage is *not so much in production* as in distribution of necessities.

50 per cent of our perishable food stuffs are spoiled — the motor truck will correct this condition.

Without motor trucks, the delicious Imperial Valley Cantaloupe would fail of a market. Melons must be moved at once or their value is lost. Conditions in Imperial Valley are such that only trucks can meet the transportation needs. The trucks go into the fields, where the heat is intense, and fight their way through sand that often reaches to the hubs.

To do full justice to ourselves and the world outside, we must conserve all of our surplus and stimulate not only production but also distribution—transportation—to the limit.

The motor truck is vital to business progress.

Motor transportation is a vital growing part of the nation's business. It is economical, invaluable in emergencies, furnishing greater protection to goods, adding business prestige—and is a real creative business force—a *Builder of Business*

The Captive Balloon and the Fruit Grower

AERONAUTIC implements for the farm! It sounds almost like a Jules Verne romance, but to southern California citrus growers aeronautic implements are a reality backed by patents. At the moment when the nation, and the world for that matter, was keeping its eyes glued on trans-Atlantic flights, a wide-awake Californian was harnessing balloons for important work on the farm.

The accompanying illustration shows a small captive balloon of 3,000 cubic feet capacity lending a citrus grower a helping hand with his fumigating. The balloon is seen lifting a fumigating tent and setting it down over a tree marked out for a treatment of potassium cyanide. Invariably the gas bag executes its work with astonishing swiftness and precision and virtually eliminates all work from an otherwise "mean" job.

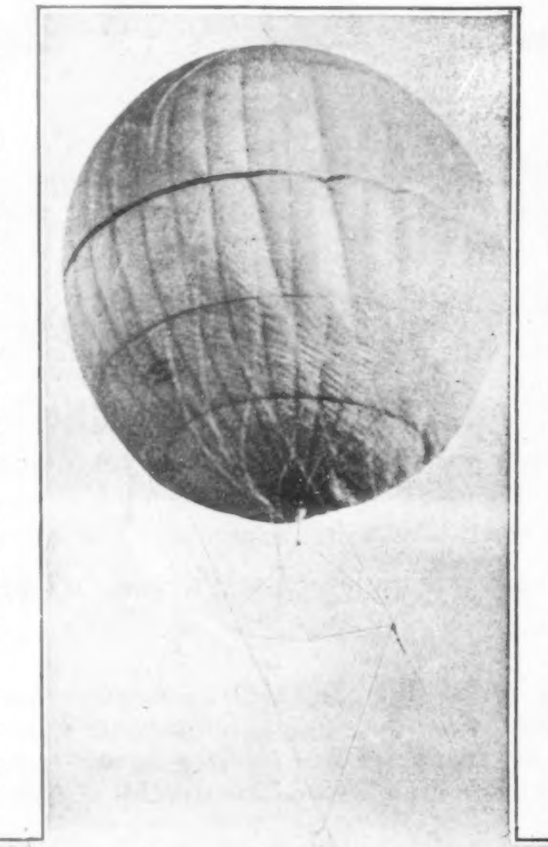
The trick is simple. The tent is attached to the balloon in place of the usual parachute. As two men pay off rope the balloon rises, carrying the tent aloft over the tree to be fumigated. The tent during its ascension resembles a great old fashioned hoop skirt as it is kept expanded by means of a large hoop encircling its base.

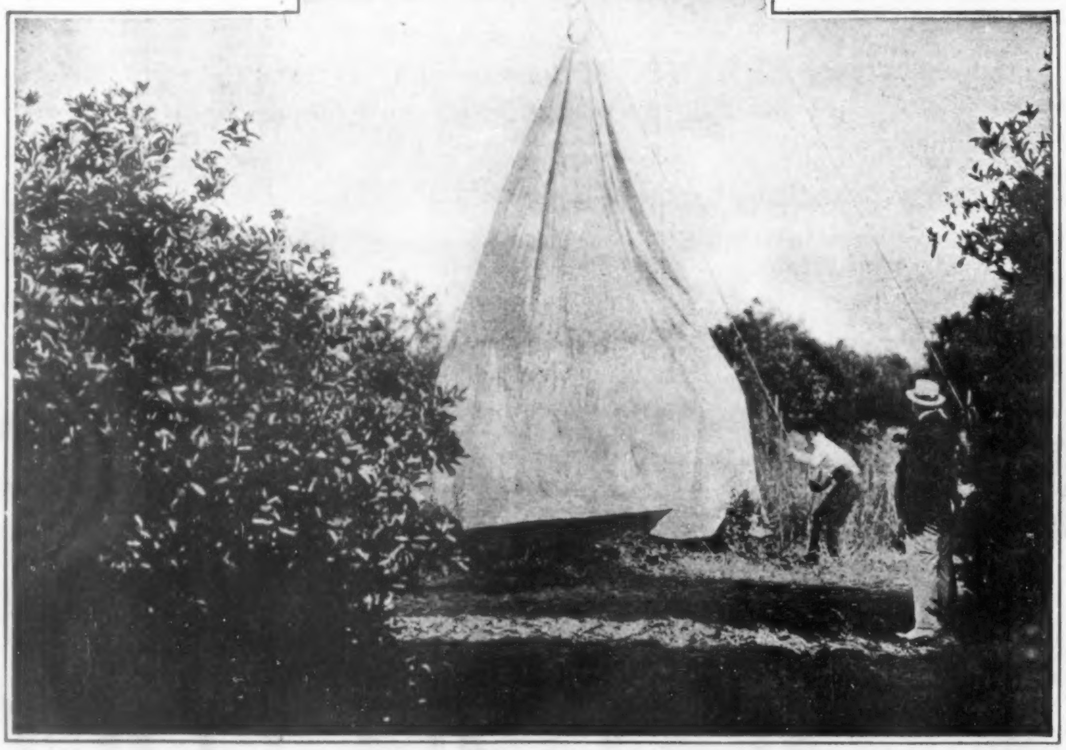
The instant the tent clears the top of the tree the men reel in dragging the balloon earthward. The tent, of course, falls over the tree enveloping it with the same precision and ease one uses in covering his head with his hat. As soon as the tent is in position the balloon is cut loose. The tree itself then supports the tent.

On the same principle that a boy sends a "message" up to his kite, the balloon is recoupled to the tent. A guy rope leading from a trip hook at the top of the tent and held by one of the men is slipped through a ten-inch ring affixed to the lower end of the bag. As the men pay off rope the balloon rises and the ring slides upward along the guy rope until it reaches the trip hook which snaps automatically, securing the ring and the balloon.

The balloon and a crew of four men place between twenty-five and thirty tents an hour over large Valencia trees. The derrick outfit which it is expected to replace with seven men places but fourteen or fifteen tents an hour. The distinctive advantage, however, of raising tents by balloon is that practically no damage of any kind is done either to the trees or young fruit. Heretofore, many citrus growers have been between the devil and the deep sea so far as fumigating and parasitical scale are concerned.

Mr. Mack Swain of Los Angeles is the inventor. The scheme is covered by patents and its success has been amply demonstrated before the California Citrus Growers Association during the latter part of July.





There is no quicker or better way to handle a fumigating tent than by means of a small captive balloon, according to a California inventor

A Plant Breeders' Opportunity

FOR a good many years commercial producers of vegetables and fruits have used a double standard in selecting varieties to grow. One standard is the table quality of the vegetable or fruit, a matter of first interest to the consumer, while the other is the shipping quality of the variety. Because there is conflict between these two standards, some of the choicest varieties of vegetables and fruits are seldom obtained outside of home gardens. No matter how well consumers like them, it does not pay the commercial producer to grow varieties that are likely to spoil in transit or while still in the dealer's hands. The matter of yield is also a vitally important point, though one the ultimate consumer is usually ignorant of.

Development of commercial varieties in the fresh vegetable and fruit industries has reached the stage where varieties which meet the requirements of this double standard are amply possessed in most cases. Indeed, for some years there has been a drastic restriction in the number of varieties grown, notwithstanding the perennial seed catalog announcements. In another direction, however, development of new varieties, urgently needed, is in its infancy, and glowing opportunities await the plant breeder. We have reference to the by-product industries, canning, evaporating and the like, which are now experiencing great growth.

The by-product factory applies to a vegetable or fruit not the double standard of the commercial producer, referred to above, but one demanded by its own business. If the manufacturer is an evaporator, he wishes a variety which, while making a first-class finished product, is especially adapted to his manufacturing conditions, and in particular, because he buys by weight and sells by weight, one which undergoes minimum shrinkage in the evaporating process. If he is a canner, some other consideration will determine for him the acceptability or otherwise of a particular variety.

With strawberry canners, for example, the husk of the common fresh market varieties is a source of great current dissatisfaction. In 1919 it cost $40 a ton to husk strawberries for canning. "The man who can produce a strawberry which husks easily," said one canner, "and yet is a firm berry for canning, can make a fortune." This fault found by a canner in the standard market strawberries illustrates well the different viewpoint. To the producer and consumer of fresh strawberries the husk is a minor matter.

When any garden or orchard product is not used fresh, but subjected first to some manufacturing process, various physical aspects suddenly acquire importance. The water content or different varieties is carefully noted by evaporator buyers. Thus under the peculiar local conditions of a North Pacific potato district, the local evaporator found that the Gold Coin variety had a smaller water content than other potatoes. This evaporator consequently bought Gold Coins in so far as possible. The potato at best is mostly water. In using a variety which carried less water by several per cent than other varieties the manufacturer materially lowered his production costs.

A Western plant breeder who is doing exhaustive work with apples has one promising variety which he thinks eventually may attain popularity as an evaporator apple. It is a variety which contains an exceptionally low percentage of water. It is an apple with a hard, tough meat, and for eating purposes has absolutely nothing to commend it. For the special purposes of the evaporator, however, it has qualities which make a strong bid.

An idea held by some unenlightened consumers is that canning and evaporating concerns use only such fruit and vegetables as are unsuitable for shipment and sale fresh. Some people still believe that the canners use only culls. The fact of the matter is that canners and evaporators are as particular as anybody in what they buy. They use first-quality produce for which they pay excellent prices. They want a very definite kind of thing. That is why there are opportunities at present for plant breeders who will attempt to supply what these industries now demand in the way of new varieties.—*J. T. Bartlett.*

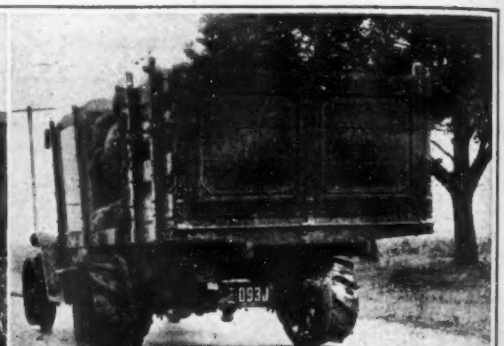
White Pine and Butter

THE interdependence of one manufacture on another is as well understood by commercial men as that of the interdependence of each part of the physical body in man by the doctors, but the layman has difficulty in seeing any connection between, say, the shortage of white pine in New Zealand and Australia and the butter served up for his daily meals.

The fact is, that no other timber has been found out there which is absolutely devoid of taste or smell, and every housewife knows how susceptible butter is to becoming tainted by any strong odor, therefore odorless wood is needed for butter tubs. Formerly there was much waste in making these but an ingenious manufacturer has perfected a tub which looks like the old one, but is made of two thicknesses of veneer 1/16 inch thick, cemented on to nailing pieces at the ends and in reinforcing pieces at intervals. Formerly box boards had to be cut from timber stacked six months. Veneer may be used in two days and 17 times as many tubs can be taken from a given quantity of logs.—*D. Waterson.*

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The detachable flanged steel tire that enables a truck to run with equal facility in the field and on the road, and how it helps the farmer to market his crops more cheaply by eliminating handling

One Truck for Road and Field

AMONG the many directions in which the trend of truck and tractor design is taking us, none is more pronounced than the tendency toward the evolution of a machine that will operate with equal facility on the road and in the field. The average citizen who does not bother his head about etymologies might be pardoned for harboring the supposition that the word tractor had been invented to designate a contrivance for hauling farm machinery about the fields, and that in the absence of a cutter or a reaper or a harvester behind it, a hauling unit could not properly be designated as a tractor. The fact is, however, that the only reason for the very sharp line of demarcation between the field tractor and the road tractor has been the fact that it was not at the beginning possible to design a machine that would give good service under both field and road conditions, and the further circumstance that the use of the truck on the road as a locomotive to haul trailers is of itself one of those obvious things concerning which we are but now commencing to ask ourselves why we never thought of that before.

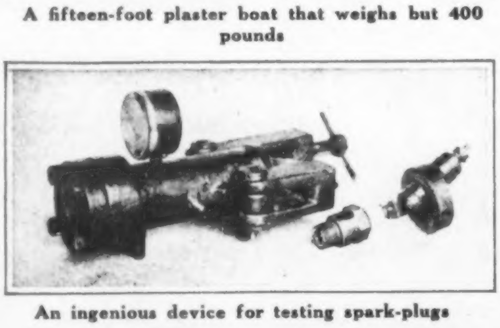
Be the circumstances what they may, however, the fact is that to-day we are confronted by the demand for the machine that will work with equal facility in the fields harnessed to a harvester or gathering up a crop on the very spot where it was produced, and on the road as a truck or a tractor. Perhaps some day we shall arrive at a model which will do all this without any shifting of equipment, though it seems a pretty large contract. For the present we are well satisfied with an arrangement that will convert the road machine, in a minimum of time and with a minimum of labor, into the field machine. And perhaps as effective an instrument to this effect as has been devised is the groused steel tire shown in the pictures at the top of this page.

We are familiar enough with the grouser as a means of giving the field tractor a better grip on the soft ground over which it works. But we are equally clear that there is no place on the road for a grouser—except in connection with a steam roller for the avowed purpose of tearing up the road surface. The manufacturer of the ground gripper shown herewith has met this with a grousing attachment that comes right off when it is desired to negotiate a bit of regular road, and goes right back on again when we come once more to field work, or reach a bit of eighteenth-century road surface which might give us trouble if we attacked it without reinforcements. The ease with which this steel super-tire goes on and off is indicated in our first picture. An outstanding merit is here shown up very clearly—the steel tire goes on right over the rubber one. It is accordingly not necessary to remove the latter, and a good deal of the benefit from its resiliency is retained as we run on the flanged steel surface.

A Plaster Boat

IF we can have a concrete boat there seems no inherent reason why we cannot have one of plaster; and an inventor in Portland, Ore., Mr. J. B. Lindberg, has actually given us one. His boat is fifteen feet long and weighs 400 pounds. Its sides are three-quarters of an inch thick, and as our caption indicates, are made of ordinary building plaster. The boat is cheaper than a wooden one, and the inventor believes it will last longer. Its advantage over a concrete craft is mainly that of lightness. The construction is also much easier, since the plaster requires an inner and an outer form to a much less extent than the concrete. In large part this lighter material can be laid down over a single form, much like a series of coats of paint. Mr. Lindberg's boat has been put in commission, and seems to be quite seaworthy and easily handled.

A fifteen-foot plaster boat that weighs but 400 pounds



An ingenious device for testing spark-plugs

Cleaning out a swimming pool with a vacuum cleaner

For Testing Spark Plugs

IT will be of interest to know that Chicago engineers have succeeded in producing a spark plug tester. It has been known for years, that carbonized and cracked spark plugs often produce very puzzling results. They seem to fire correctly in the open air but when replaced in the engine cylinder, their serviceability becomes questionable, in many cases causing great loss of time and difficulty of operation.

Compression chambers have been attempted, in which efforts were made to place spark plugs under heavy air pressure to similate compression. The questionable plug to be tested, was to be screwed into a tapped hole in the wall of a chamber, air pumped into the chamber, and then the condition of the spark on the plug observed through a thick glass lens. However, this method proved a failure as the average spark plug permits air to escape and if one happens to be air tight, the joint between it and the chamber is almost sure to leak, relieving the pressure that is essential to the test.

The new spark-plug tester, which has just been completed and which is being fully protected by patent proceedings, places the whole plug inside of the chamber. Access to the interior is obtained by using a removable cap pressed firmly against the cylinder end with suitable yokes. The terminal of the plug within is connected to an exterior source of high voltage current, through an insulated connector passing through the cap. All fixed joints are made air tight as well as the joint between the removable cap and the end of the cylinder. A heavy glass lens at the end of the cylinder opposite the cap permits a view of the interior. Several other ignition tests can be made with this same device.

The Vacuum Cleaner in the Swimming Pool

A DEVICE for cleaning swimming pools of the constantly accumulating cuticle, lint, hair, dye from clothing and plain dirt tracked in, has been evolved after the principle of the suction or vacuum cleaner. The equipment is supplied with either a rotary or centrifugal pump. At the bottom of the handle is the cleaning tool. This is made of phosphor bronze and has a brush attachment that easily dislodges any sediment which has adhered to the pool. The water and material sucked up in the process is bypassed direct to the drain before reaching the filters.—*A. H. Pulver.*

Coal and Iron from the Arctic

(*Continued from page 363*)

era in its commercial development, its mining period. Although its existence there was known to the earliest explorers, it is only during the last few years that coal has been exported from Spitsbergen in any quantity. Indeed, the first claim to coal-bearing land was not made till 1900, when a Norwegian firm extracted a few tons of coal from their estates at Advent Bay and sent it to Norway as a sample. At that time the Norwegians could have taken every coal bed in Spitsbergen without opposition, but they let the opportunity slip.

The two largest land-owners in Spitsbergen to-day are the British syndicates, one of which lays claim to about 2,000 square miles of territory, and the other to 1,800 square miles. Only mining companies in Great Britain, Norway, Sweden, and Russian own land in Spitsbergen to-day. The two British enterprises together own over one-seventh of the whole country, and this proportion seems likely to be increased this year. The Norwegians own some 800 square miles, Sweden about 350 square miles, and the single Russian company about 60 square miles.

The question of titles to land is most important. So far the practice has been for a mining company, on taking land, to erect notices to that effect, and to notify their own Foreign Office, where the claim is registered, if no previous claim invalidates it. This notification constitutes the real title-deed, and the British Foreign Office several years ago promised British mining companies that their claims would be safeguarded. All land titles of the two British companies named above are perfectly valid and beyond dispute. The same is true of the Norwegian, Swedish, and Russian estates. But Spitsbergen has already attracted adventurers, and complications are bound to ensue owing to attempts to jump claims.

The question of the establishment of some form of government over this Arctic archipelago is therefore of paramount importance. During its earlier history it has been claimed by Holland, Britain, Denmark, and Norway. Holland claimed it by right of discovery, while in 1614 it was annexed by Great Britain who for many years maintained a colony there. Both these claims were no doubt valid in their day. Denmark also laid claim to the islands on the contention that Spitsbergen was a part of Greenland, and therefore Danish. The King of Norway, based his rights to the islands on the plea that he was lord of the northern seas and therefore was sovereign of the lands therein. When the whaling and fisheries declined all these rival claims were forgotten. Russian never bothered to claim Spitsbergen in the days when Russia trappers colonized it.

Little then was heard about the ownership of the islands until the separation of Norway and Sweden in 1905. But the sudden and rapid opening of the country to mining brought the question prominently to the fore, and in 1909 Norway came forward with proposals which had a distinct bias towards Norwegian control, while purporting to maintain Spitsbergen as a No-Man's Land. But nothing was achieved, largely because of the mutual jealousy of Norway, Sweden, and Russia. The matter was not dropped. Subsequent conferences met in 1910 and 1912, and made such good progress that a larger conference, at which all States interested, including Great Britain, the United States, and Germany, were represented, met at Christiana in June, 1914, in the hope of coming to a final decision. The discussions, however, were protracted, largely due to the obstruction of Germany and no conclusions were reached when the conference broke up on the outbreak of the war in August.

At the request of Norway the subject was brought up again in connection with

(*Continued on page 378*)

LEGAL NOTICES

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year \$5.00
Scientific American Supplement (established 1876) one year 5.00

Postage prepaid in United States and possessions, Mexico, Cuba and Panama

Foreign Postage

Scientific American \$1.50 per year additional.
Scientific American Supplement \$1.00 per year additional.

Canadian Postage

Scientific American 75c per year additional.
Scientific American Supplement 50c per year additional.

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application

Remit by postal or express money order, bank draft or check

Coal and Iron from the Arctic

(Continued from page 376)

the Peace Conference, and the future of Spitsbergen was discussed without active German participation. Press despatches of late August represented practically all powers as ready to withdraw in favor of Norway; in fact, a Spitsbergen Treaty on that basis had actually been drawn at this date, and the only nation which seemed likely to withhold signature was Sweden. The document was passed along to the Supreme Council during the last week of August, after which it was to be sent to Norway for examination. Ratification by the great powers was expected to be complete before the New Year; and while the smaller nations were to be given opportunity to ratify, their action was not regarded as necessary to put the Treaty into operation.

The difficulty in solving the problem of control lies not so much in deciding what State shall be given the mandate as in devising adequate safeguards for the preexisting estates belonging to the nationals of other countries. Obviously companies which have been in Spitsbergen for many years cannot be expected to submit to control prejudicial to their interests: they will not submit to laws which hamper their operations, especially if those laws emanate from a State other than their own. Unless the controlling hand rests lightly in Spitsbergen, either British or Norwegian estates will have to be extra-territorial in so far as they ante-date the new order of things. The Treaty as passed up to the Supreme Council provided for the protection of the rights of all nationals having rights in Spitsbergen through an International Arbitration Tribunal, which would also settle all disputes and claims. Whether this scheme is open to the objections which hold against explicit internationalization can probably only be determined by trial.

The resources of the country are considerable both in minerals and building stones, and in fur. About fur, little need be said, since the hunting of fur-bearing animals, reindeer, foxes, and polar bears, at least in the more accessible parts of the country, will not again be a profitable occupation until some game laws have been instituted which will allow the game to recover from the excessive slaughter by so-called sportsmen and Norwegian hunters.

The mineral resources include coal, iron ore, copper ore, oil shale and possibly free oil: further examination will probably reveal others. The coal is Carboniferous, Jurassic, and Tertiary. All these kinds occur in enormous quantities and mostly in seams easily worked within a few hundred yards of deep water anchorage. The Tertiary coal is the best, and in practice has been proved to be excellent steam coal. No one knows the amount of coal available in this Arctic archipelago, but it has been estimated at 8,750 million tons.

Magnetic iron ore of high quality has recently been discovered on the British estates. One of the "plums" is a mountain, 2,000 feet high and stretching for miles along Recherche Bay, which is nothing less than a mountain of iron. It is probably the largest iron-ore deposit in the world and one of the richest, the analysis showing an average of 66 per cent of pure iron. As far as it is known this high-grade ore does not occur on any Scandinavian estate. The British estates also contain enormous quantities of pure gypsum and some promising oil shale, asbestos and molybdenum and per ores, and marble of fine quality.

An essential need in Spitsbergen mining to-day is the adequate examination of the estates by qualified geologists and mining engineers. Trustworthy reports from men of standing are required in order to give sufficient confidence to allow the development of a country which suffers in reputation from its far northern position, its association with the Arctic regions, and its heretofore anomalous political status.

A Loop of Wire

(*Continued from page 368*)

as ingenuity and available facilities dictated.

The transmitter was a quenched spark two circuit system, excited by the German high-pitched buzzer transformer. Inductively coupled to the primary circuit was the loop antenna circuit which consisted of a coupling coil in series with the loop antenna and a mica condenser. A small oil condenser for vernier tuning of the loop was placed in parallel with the mica condenser. This was done to provide sharp tuning of the transmitter when the loop antenna was stretched by emergency ties in cases where its mast had either been lost or broken. Three wave lengths were provided—110, 123, and 140 meters. In transmission, the turns in the loop were connected in parallel to obtain low resistance in the circuit. A double throw switch transferred the circuit from transmission to reception.

The receiver consisted of two turns in the loop, series connected, and placed across the previously mentioned vernier oil condenser. This gave a wave length range of 85-165 meters. The detecting device was a vacuum tube. The circuits were arranged so that this tube might pass from the detecting to the oscillating stage and operate on the intermediate or regenerative point. This was accomplished by connecting one side of a third turn of the loop with the plate of the tube and the other side to the filament of the tube through a 40-volt dry battery and the telephones. Around the telephones and plate battery was placed a variable air condenser for adjusting the coupling between the plate and antenna circuits. For very small values of capacity, the tube acted as a detector, and for large values, as an oscillator. Intermediate values were used in receiving.

The sets were taken to the front for demonstration and criticism. The tests showed thoroughly reliable communication between sets in dugouts separated six kilometers when using only 30 watts with locked key. Capt. Robert Loghry, Chief Radio Officer of our Army in the field, reported enthusiastically in favor of this system and upon the opinion of both the French and American Signal Staff, Geieral Russell, decided to base his front-line communication upon these sets.

In order to facilitate and expedite the production, Lieut. Priess was sent to the United States for a six weeks' period. He was authorized to manufacture a number of models incorporating the several improvements that were possible with the better manufacturing facilities provided in the United States.

Fifty-two days after his arrival three sets had been built under his direction and were tested before General Squier and a staff of officers from the various Army Departments. It weighed only 28 pounds and included all the transmitting and receiving apparatus, the loop antenna, loop unit, compass, telephones, tools and spares.

Many unique features entered into the design of this compact unit. One of the most important resulted in the development of a buzzer operating from a 10-volt storage battery. The break for the buzzer was only a few mils but it handled 10 amperes, without sparking at this break, and transformed the 10 volts direct current to 3500 volts, 500-cycle alternating current with an overall efficiency of 65 per cent. The secret for this operation was the radio frequency quenching circuit included around the break. This circuit consisted of a large efficient condenser with very short connecting leads, and the break. In operation the condenser was charged to double the battery voltage and upon the breaking of the armature from one contact to the other, the condenser circuit discharged in the opposite direction and quenched the arc when its current reached the value of the arc current. The phenomenon of current equalization was consummated in about 1/60,000 of a second and consequently produced sparkless breaking.

In the network diagram two regiments, A and B, are attached to the brigade. Each regiment consists of battalions 1, 2 and 3. Each battalion controls four companies, 1, 2, 3 and 4. It is important that a battalion be in communication with its four companies and, at the same time, its regiment. The bulk of communication is in the direction of the attack or axis of the troops. Emergency communication, however, must be provided for in case any of the control units are annihilated.

It was planned to utilize three wavelengths for obtaining this control. Battalion 1 and all its companies operated on the short wave. Battalion 2 and its companies operated on the medium wavelength. Battalion 3 and its companies operated on the long wavelength. The adjacent companies and battalions of a contacting regiment would therefore be operating on the maximum difference in wavelength. This eliminated interference.

In actual operation, location and condition reports travel rearward. All sets are normally on the receiving position. Orders for maneuvers are reported forward. For example, if Company 2 of the 2nd Battalion of Regiment A encounters stiff resistance and wishes a barrage, this would be transmitted back to Battalion 2 on the medium wavelength. Battalion 2 would call Regiment A, and transmit this information with recommendations likewise on the medium wavelength. In this case none of the companies of the other battalions of Regiment A would hear this communication because of the difference in wavelength. The other companies in Battalion 2 would not hear the communication because of their orientation. The second battalion of adjacent regiments would likewise not hear the communication because of the distance of separation. In the reverse case, if Regiment A wished to communicate with Battalion 2 it would transmit on the medium wavelength, Battalion 2 being normally on the position of receiving medium wavelength would be the only battalion to receive this communication. The further advantage possessed by tion.

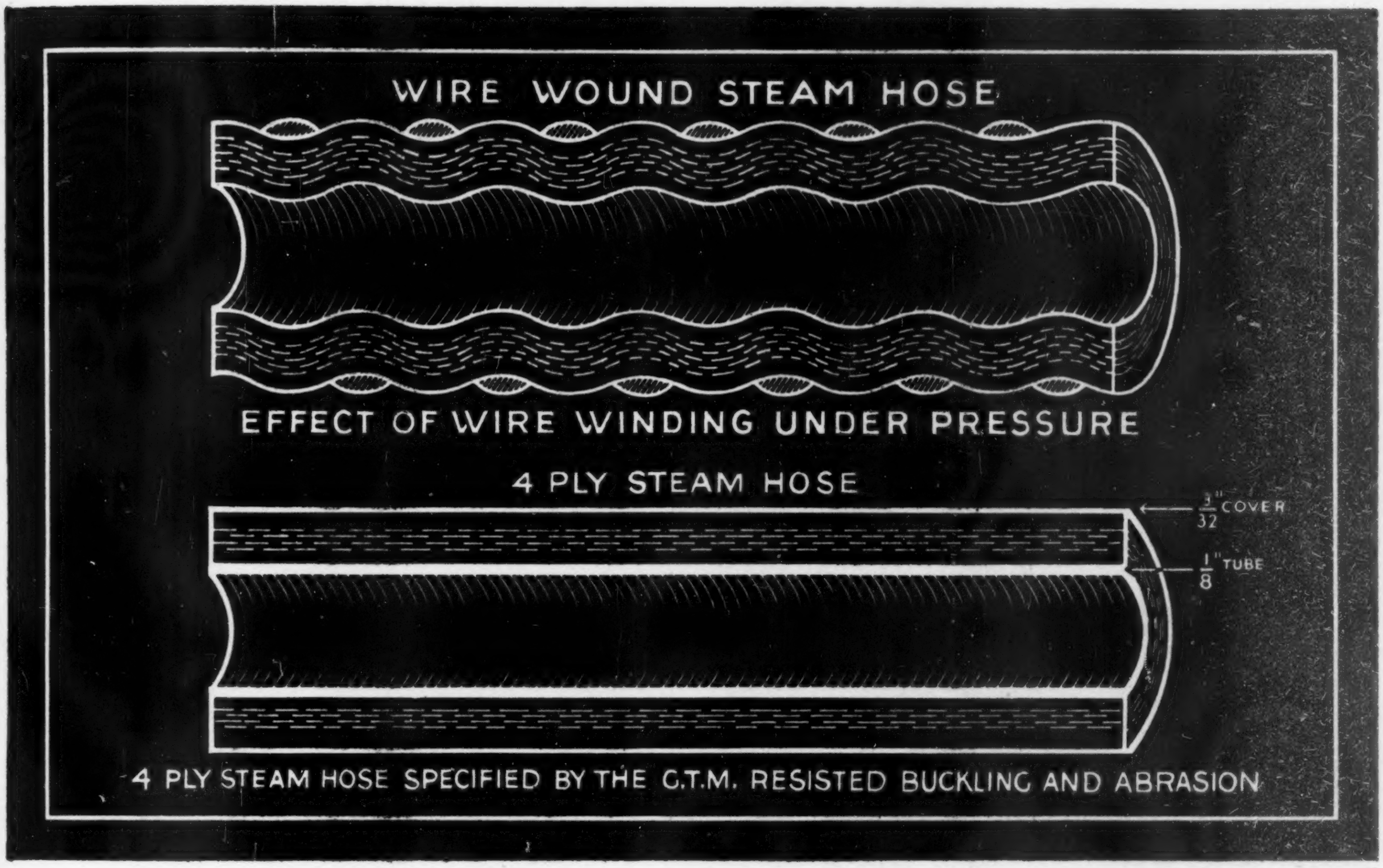
The Pheasants and Their Book

(*Continued from page 367*)

ing, all handsome and attractive birds.

The shy and little-known argus pheasant, is one of the most marvelous of all, for while he lacks brilliance of plumage, he more than makes up in intricacy of pattern. He is a large bird, nearly the size of a peacock. The two central tail feathers are produced to a length of several feet, while the secondary feathers of the wing are unusually long and broad. It is on these feathers that we find the greatest wonder, for each one is decorated with a row of tiny, delicately shaded circles which, when the feather is rotated in the hand, seem to be as many spinning, elusive balls. The argus pheasant now living in the New York Zoological Park is probably the only member of his species in America.

Interest in the study of these gorgeous birds recently has been stimulated by the publication of the first volume of the long-awaited Monograph of the Pheasants, by William Beebe. Mr. Beebe spent seventeen months in study of the birds in their native haunts, and devoted several ensuing years to work on the great amount of material gathered. The resulting Monograph is published by the New York Zoological Society, with the coöperation of Colonel Anthony R. Kuser, without whose aid a financial undertaking of such magnitude would not have been possible. Our illustrations are reproduced from the pages of the book and give some slight idea of the lavish hand with which Mr. Beebe's pages are adorned.



Steam, Wire, Rubber—and the G. T. M.

That steam hose had to be protected with wire, was long taken for granted by the Beach City Silica Sand Company, at Beach City, Ohio. Of course the hose had a habit of suddenly choking up and having to be discarded, but it had always done that, so they thought it was natural enough. In their experience, hose and steam didn't go well together anyway, and besides the wire seemed necessary for protecting the cover when it was dragged over sand, gravel and rock.

But one day a G. T. M.—Goodyear Technical Man—called on Mr. Oliver, president and general manager. And before he left he showed Mr. Oliver something about wire, steam and rubber. When he first came in he was asked what he had to sell. "Steam Hose," said he. "What's the price?" was the answer. "I want to show you something about hose first," said the G. T. M. "Oh, I see; you're one of the fellows that have something a little better than anybody else." The G. T. M. admitted that he was, and that the something better was just what Mr. Oliver needed to cut down his steam-hose bills.

He showed him a sample of 4-ply Goodyear Steam Hose—of Monterey construction—*not* wire-wound. Mr. Oliver immediately pointed out that their hose had to be dragged over rough, sharp surfaces and needed wire protection. And then the G. T. M. explained what wire-winding does to steam hose—how the alternate heating and cooling, pressure and deflation involved in using steam hose, expand and contract the body of the hose more than they can expand or contract the wire-winding. In consequence the inner tube of the hose separates from the fabric plies, causing a blister which sooner or later closes up and prevents steam from getting through in the required volume.

Then he told him about the rubber cover of that piece of Goodyear Hose, how it was compounded to resist abrasion, and how it did resist it. Mr. Oliver was interested, said he had never thought that wire-winding was harmful or that a properly compounded cover could do what that Goodyear cover seemed to be able to do. But he said he didn't need any hose just then.

A month later he ordered according to the G. T. M.'s recommendation—ordered by mail. Some time later the G. T. M. saw him. He was perfectly satisfied, introduced the G. T. M. to some of his friends and told them that if they wanted to save money on belts and hose to let him analyze their conditions and prescribe the goods to meet them. And he added, "He told me something about steam hose that I never knew before; after he left I proved it by cutting up an old piece of hose. And the hose he recommended is rendering exceptional service." Of course the Beach City Silica Sand Company continues to order its hose from Goodyear, in accordance with the G. T. M.'s recommendation.

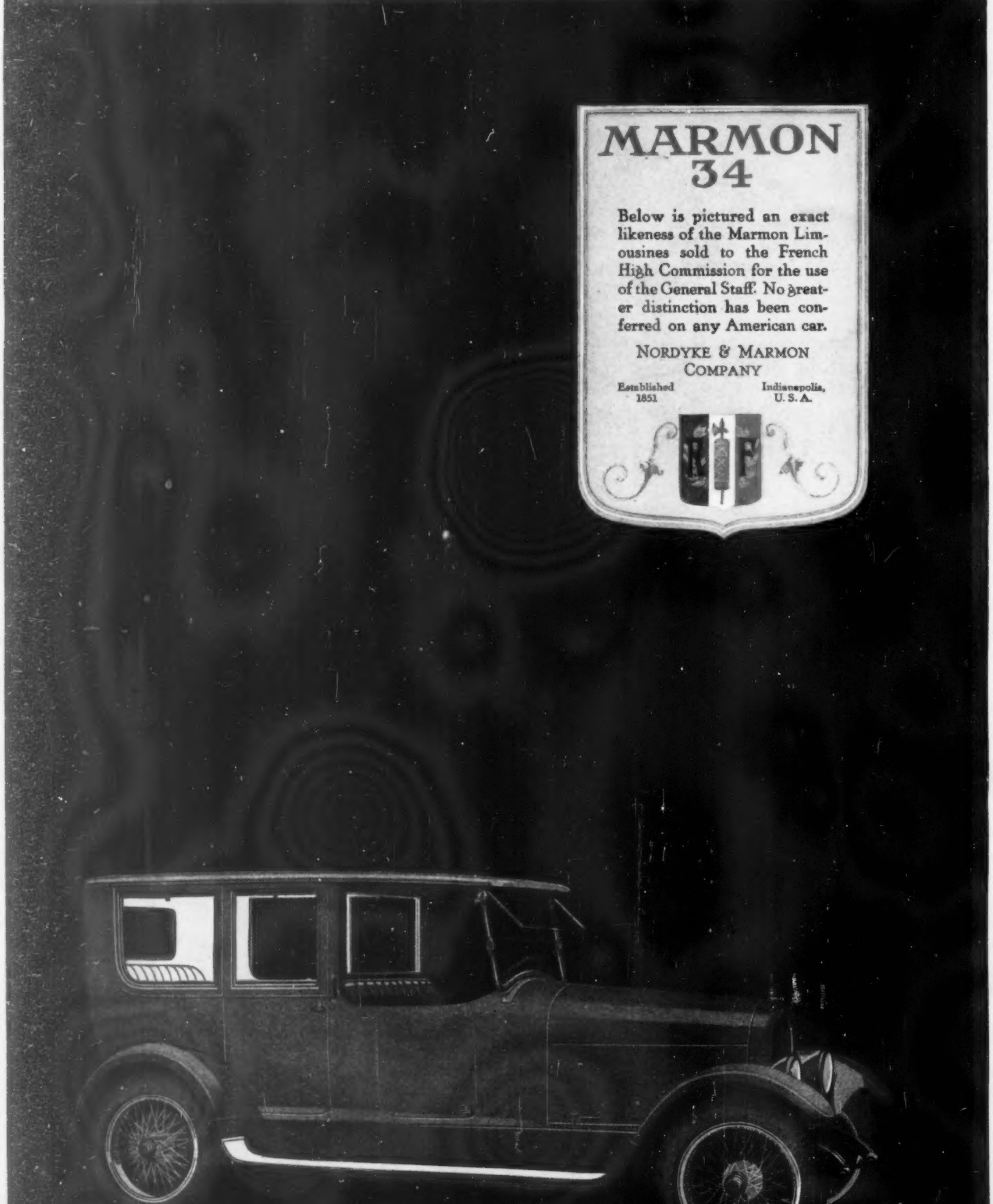
If you have never challenged your steam and water hose bills, ask a G. T. M. to call. He'll do so when next in your vicinity. His services in the matter of hose are free—just as they are for belts. The good will resulting from the economies the G. T. M.'s effect, is always certain to result in a gratifying volume of business within a few years.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

BELTING · PACKING HOSE · VALVES

GOODYEAR

AKRON


MARMON
34
Below is pictured an exact likeness of the Marmon Limousines sold to the French High Commission for the use of the General Staff. No greater distinction has been conferred on any American car.
NORDYKE & MARMON COMPANY
Established 1851
Indianapolis, U. S. A.